TM-102848

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AIRCRAFT CORPORATION, STEVENAGE

INSTRUCTION MANUAL

NETWORK ANALYZER

MODEL 305-PA-3009

SEPTEMBER, 1976

DRANETZ
ENGINEERING
LABORATORIES
INCORPORATED

TWX: (710) 997-9553
CABLE: DRANETZ

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SERIAL NUMBER EFFECTIVITY

Instruction Manual TM-102,848 provides maintenance and operating instructions for Plug-in Model 305-PA-3009 units determined by the foll following Serial No. codes:

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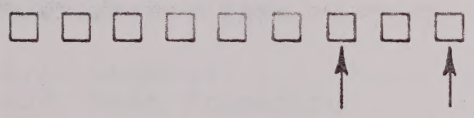
9 DIGIT EXAMPLE



Plug-in 305-PA-3009 Notes:

1. If last digit (9th digit) is 6 or greater and the 7th digit is 3 or greater; this manual applies.
2. If last digit (9th digit) is 7 or greater; this manual applies.

305-PA-3009 INSTRUCTION MANUAL

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102,253 ASSY CARDS 3&4
102,255 SCHEMATIC CARDS 3&4
102,848 ASSY 305PA3009
102,849 ASSY CARDS 1&2
102,850 SCHEMATIC CARDS 1&2
102,623 SCHEMATIC CARD 5
102,620 ASSY CARD 5

SECTION 1

GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides operating and service information for the Dranetz Model 305-PA-3009 Network Analyzer Plug-in manufactured by Dranetz Engineering Laboratories Incorporated, South Plainfield, New Jersey. This plug-in may be used in all Dranetz Series 305 phasemeter main frames.

1.2 PURPOSE

The purpose of this plug-in is to expand the usefulness of Dranetz Series 305 phasemeters by adding the ability to measure the voltage of both inputs in either volts or dB reference 1 Volt= 0 db. The ratio in dB of the "Signal" input with respect to the "Reference" is also measured.

1.3 CHARACTERISTICS

The detailed characteristics of the 305-PA-3009 when used in a series 305 phasemeter are specified by Table 1-1 which follows:

TABLE 1-1, 305-PA-3009 SPECIFICATIONS

INPUT LEVEL RANGE:

10 mV rms to 40 V rms both inputs.

INPUT IMPEDANCE:

1 Megohm plus 40 pf both inputs, usable with standard oscilloscope probes.

INPUT FREQUENCY RANGE:

2 Hz to 700 kHZ

FUNCTIONS:

Amplitude of reference input in volts or dB ref 1 volt,

TABLE 1-1 SPECIFICATIONS (cont.)

Amplitude of signal input in volts or dB ref 1 volt, Phase angle of signal input with respect to reference input, and Ratio of signal input to reference input in dB. The function to be displayed is selected by a switch on the front panel of the plug-in.

ANALOG OUTPUTS:

Four Outputs are simultaneously available at the rear of the phasemeter main frame. They are proportional to Reference input level (in either volts or db), Signal input level (in either volts or db), Phase Angle of Signal with respect to reference, and ratio of signal to Reference in db. The sensitivity of all db outputs is 10 mv/db. The sensitivity of the phase angle Output is 10 mv/ degrees (a positive output indicates that Signal leads Reference). The voltage amplitude outputs have one of 3 sensitivities depending on which voltage range is in use. Sensitivity is 10 volts/ volt in the mv x 1 range, 1 volt/volt in the mv x 10 range and 0.1 volt/volt in the volts ÷10 range.

VOLTAGE RANGE SELECTION

Fully automatic

VOLTAGE RANGE INDICATION:

By indicator lamps on front panel and by outputs on rear of main frame suitable for operation of 24 vdc, 8 ma drive reed relays.

ACCURACIES (analog outputs):

Phase: $\pm$ 0.1° from 40 mV to 40 V rms from 50 Hz to 50 kHz, typically $\pm$0.25° at all other levels from 5Hz to 500 kHz.

Voltage amplitude (Volts): $\pm$ 2% of reading from 40 mV to 40 V rms from 50 Hz to 50 kHz, $\pm$5% of reading typical down to 10 HZ and up to 500 kHz.

Voltage Amplitude (dB ref. 1 Volt): $\pm$0.3 db from - 28 dB to +32 dB from 50 Hz to 50 kHz, $\pm$ 0.6 db typical down to 10 Hz and up to 500 kHz.

Voltage Ratio (dB sig./ref): $\pm$0.5 dB from -28dB to +32 dB in each input from 50 HZ to 50 kHz, $\pm$ 1 dB typical down to 10 Hz and up to 500 kHz.

TABLE 1-1 SPECIFICATIONS (cont.)

For accuracies at the front panel readout, add the error of the DVM as specified in the main frame instruction manual TM-101378A.

LEVEL LIMIT INDICATION:

Indication lamps on front panel light for Signal input below 40 mv, Signal input above 40 volts, Reference input below 40 mv, and Reference input above 40 volts. A single TTL compatible line to a main frame rear connector changes state from "1" to "0" if any of the four out-of-limit indicators light.

SECTION 2

OPERATING INSTRUCTIONS

2.1 GENERAL

The 305-PA-3009 network analyzer plug-in is operated in a Dranetz series 305 phasemeter main frame. The instruction manual for the main frame (TM-101378A) should be referred to for much of the operating procedure. Only information directly concerned with the 305-PA-3009 plug-in is presented in these instructions.

2.2 CONNECTORS AND CONTROLS

The rear connector on the 305-PA-3009 is of no concern to the operator. Its function is to properly mate the plug-in to the main frame connecting power supplies, grounds and various signal leads. The operator is concerned; however, with all controls, connectors and indicators located on the 305-PA-3009 front panel. These are identified by figure 2-1 and described by Table 2-1 which follows.

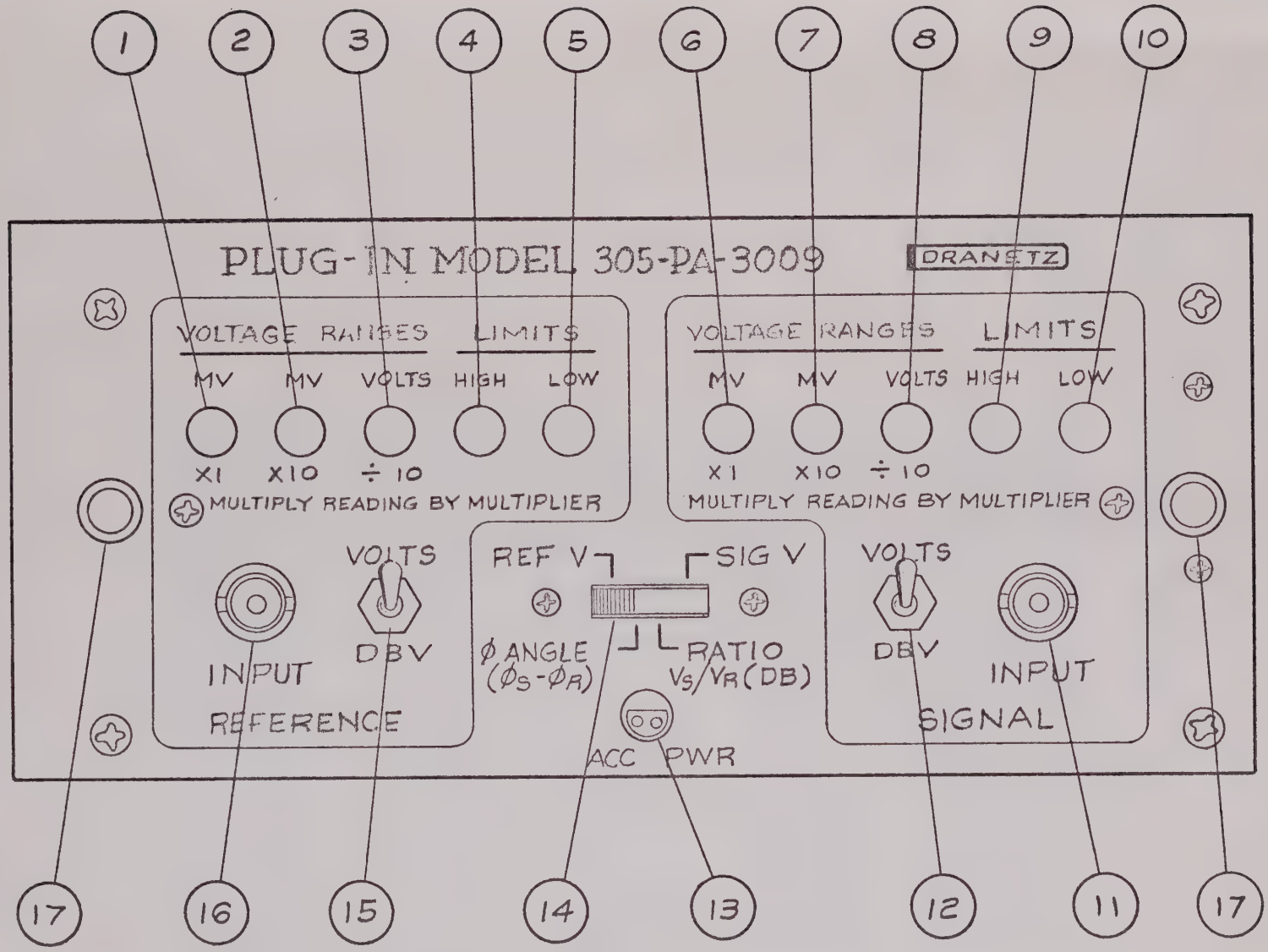


FIGURE 2-1, 305-PA-3009 FRONT PANEL

TABLE 2-1, FRONT PANEL COMPONENTS

INDEX NO.	COMPONENT AND DESCRIPTION
1.	Reference channel mV x 1 indicator lamp. When this lamp lights, Reference Voltage displayed on the main frame DPM is presented directly in mV rms. This lamp does not apply if voltage is being displayed in dBV.
2.	Reference channel mV x 10 indicator lamp. When this lamp lights, Reference Voltage displayed on the main frame DPM must be multiplied by 10 to read in mV rms. This lamp does not apply if voltage is being displayed in dBV.
3.	Reference channel Volts ÷10 indicator lamp. When this lamp lights, Reference Voltage displayed on the main frame DPM must be divided by 10 to read in Vrms. This lamp does not apply if voltage is being displayed in dBV.
4.	Reference channel high limit indicator lamp. This lamp lights when the input applied to the Reference channel approaches the 40 V rms upper limit. This lamp also blinks on when the plug-in auto ranges upward.
5.	Reference channel low limit indicator lamp. This lamp lights when the input applied to the Reference channel drops below 40 mV rms by more than approximately 10%. This lamp also blinks on when the plug-in auto ranges downward.

TABLE 2-1, FRONT PANEL COMPONENTS (CONT.)

6.	Signal channel mV x 1 indicator lamp. When this lamp lights, Signal voltage displayed on the main frame DPM is presented directly in mV rms. This lamp does not apply if voltage is being displayed in dBV.
7.	Signal channel mV x 10 indicator lamp. When this lamp lights, Signal voltage displayed on the main frame DPM must be multiplied by 10 to read in mV rms. This lamp does not apply if voltage is being displayed in dBV.
8.	Signal channel Volts ÷10 indicator lamp. When this lamp lights, Signal voltage displayed on the main frame DPM must be divided by 10 to read in V rms. This lamp does not apply if voltage is being displayed in dBV.
9.	Signal channel high limit indicator lamp. This lamp lights when the input applied to the Signal channel approaches the 40 V rms upper limit. This lamp also blinks on when the plug-in auto ranges upward.
10.	Signal channel low limit indicator lamp. This lamp lights when the input applied to the signal channel drops below 40 mV rms by more than approximately 10%. This lamp also blinks on when the plug-in auto ranges downward.
11.	Signal channel input connector (BNC).

TABLE 2-1, FRONT PANEL COMPONENTS (cont.)

12.	Signal channel VOLTS/ DBV switch. When this switch is in the VOLTS position, the Signal voltage is presented in 3 linear ranges from below 40 mV rms to 40 V rms. The range in use is designated by the Signal voltage range indicator lamps. When the switch is in the DBV position, the Signal voltage is presented in dB referenced to 1 volt = 0 dB. The voltage range indicator lamps are not relevent to dBV readings.
13.	Accessory Power Jack. This jack provides power for external isolation transformormers of the Dranetz 3100 series. Pin A provides + 24 VDC at 50 ma while pin B provides - 24 VDC at 50 ma.
14.	Function Selector Switch. This switch selects which of the four functions being measured is to be displayed by the main frame DPM. The four functions available are Reference voltage (in volts or dBV), Signal voltage (in volts or dBV), Ratio of Signal voltage with respect to Reference voltage in dB, and phase angle of Signal voltage with respect to Reference voltage in degrees.
15.	Reference channel VOLTS/DBV switch. When this switch is in the VOLTS position, the Reference voltage is presented in 3 linear ranges from below 40 mV rms to 40 V rms. The range in use is designated by the Reference voltage range indicator lamps. When the switch is in the DBV position, the Reference voltage is presented in dB referenced to 1 volt = 0 dB. The voltage range indicator lamps are not relevent to dBV readings.

16. Reference channel input connector (BNC).

17. Plug-in lock fasteners. To secure plug-in turn CW. To release plug-in turn CCW.

2.3 OPERATING PROCEDURE

2.3.1 The 305-PA-3009 must be installed in a Series 305 phasemeter prior to operation. This is accomplished by removal of the existing plug-in and substitution of the 305-PA-3009. Plug-ins are secured using 2 pawl type fasteners located at each end of the front panel.

2.3.2 An additional step is required before the 305-PA-3009 may be operated. Check the rear panel of the 305 main frame. If there is a toggle switch between the "MAIN FRAME" and "PLUG-IN" connectors, place it in the position marked "3009". If the main frame was manufactured before this switch was added one may either perform the steps which follow or may add the switch in accordance with the instructions in Section 6 of this manual. If the switch is not to be installed, remove the cover from the phasemeter main frame and cut the jumper wire between pins 6 and 7 of the MAIN FRAME" connector (J 3). After this jumper is cut the case is re-installed. The next step is installation of a jumper cable between the MAIN FRAME (J3) and PLUG-IN (J2) connectors on the 305 series main frame rear panel. The required jumper cable is supplied with each 305-PA-3009 plug-in. The two preparatory steps described here disconnect the DPM from the phasemeter mainframe and allow it to be fed from the function selector switch on the front panel of the plug-in. If the pre-wired jumper cable is lost a substitute may be constructed by making the following connections between two Cannon type DB 25P connectors:

J3 MAIN FRAME		J2 PLUG-IN
Pin 6	to	Pin 6
Pin 7	to	Pin 7

NOTE: If the main frame contains the Automatic Calibrator (Option 107), the jumper to be cut is between pin 6 and pin 8 of J3. Then, pin 8 of J3, instead of pin 7, is connected to pin 7 of J2.

2.3.3 After initial preparation operate the 305/305-PA-3009 combination as follows:

a. Turn unit on and allow a minimum of one minute for warm-up.

b. Connect inputs to both Reference and Signal input connectors.

c. Put main frame MEAS/CHECK switch in the MEAS position.

d. Select measurement desired using function selector switch on plug-in.

e. Select either voltage or DBV presentation for level measurements.

f. Allow panel meter to stabilize and read measured quantity. Angle, DB ratio and dBV are direct reading without any scale factors. Voltage readings must be modified by the scale factor shown by the Voltage Range indicator lamps.

NOTE: If main frame contains the Automatic Calibration feature (Option 107), the 305-PA-3009 function selector switch must be kept in the "Ø ANGLE" position during any automatic calibrations performed.

2.3.4 Additional operating information concerning the 305 main frames is contained in Instruction Manual TM-101378A supplied with each main frame.

2.3.5 Four simultaneous analog outputs are available at the PLUG-IN (J2) connector on the rear of the main frame. These are detailed in Table 2-2.

2.3.6 Six decimal point outputs are available at the PLUG-IN (J2) connector on the rear of the main frame. These outputs are identified by Table 2-2. Figure 2-2 shows a typical hook up illustrating the use of these decimal point outputs in conjunction with external DPM's.

TABLE 2-2, PIN DESIGNATIONS

"Plug-In" Connector (J^2) At Rear of Main Frame

Pin No.	Pin Function
1.	Level limits, "1" Normal, "0" out of limits.
2.	Ref. 10 Vdc out/Vrms in } Pin grounded
3.	Ref. 1 Vdc out/Vrms in } through PNP
4.	Ref. 0.1Vdc out/Vrms in } transistor on range in use.
5.	CKT. GND.
6.	SELECTED FUNCTION OUTPUT
7.	PHASE ANGLE INPUT, 10 mv/degree
8.	Ref. LEVEL OUTPUT, See Paragraph 2.3.7.6
9.	SIG. LEVEL OUTPUT See paragraph 2.3.7.7
10.	CKT. GND.
11.	Sig. 10Vdc out/Vrms in } Pin grounded
12.	Sig. 1 Vdc out/Vrms in } through PNP
13.	Sig.0.1 Vdc out/Vrms in } transistor on range in use
14.	RATIO OUTPUT, Vs/Vr in dB, 10 mv/dB
15.	CKT. GND.
16.	N.C.
17.	N.C.
18.	N.C.
19.	N.C.
20.	+ 24 Vdc
21.	N.C.
22.	N.C.
23.	N.C.
24.	N.C.
25.	- 24 Vdc

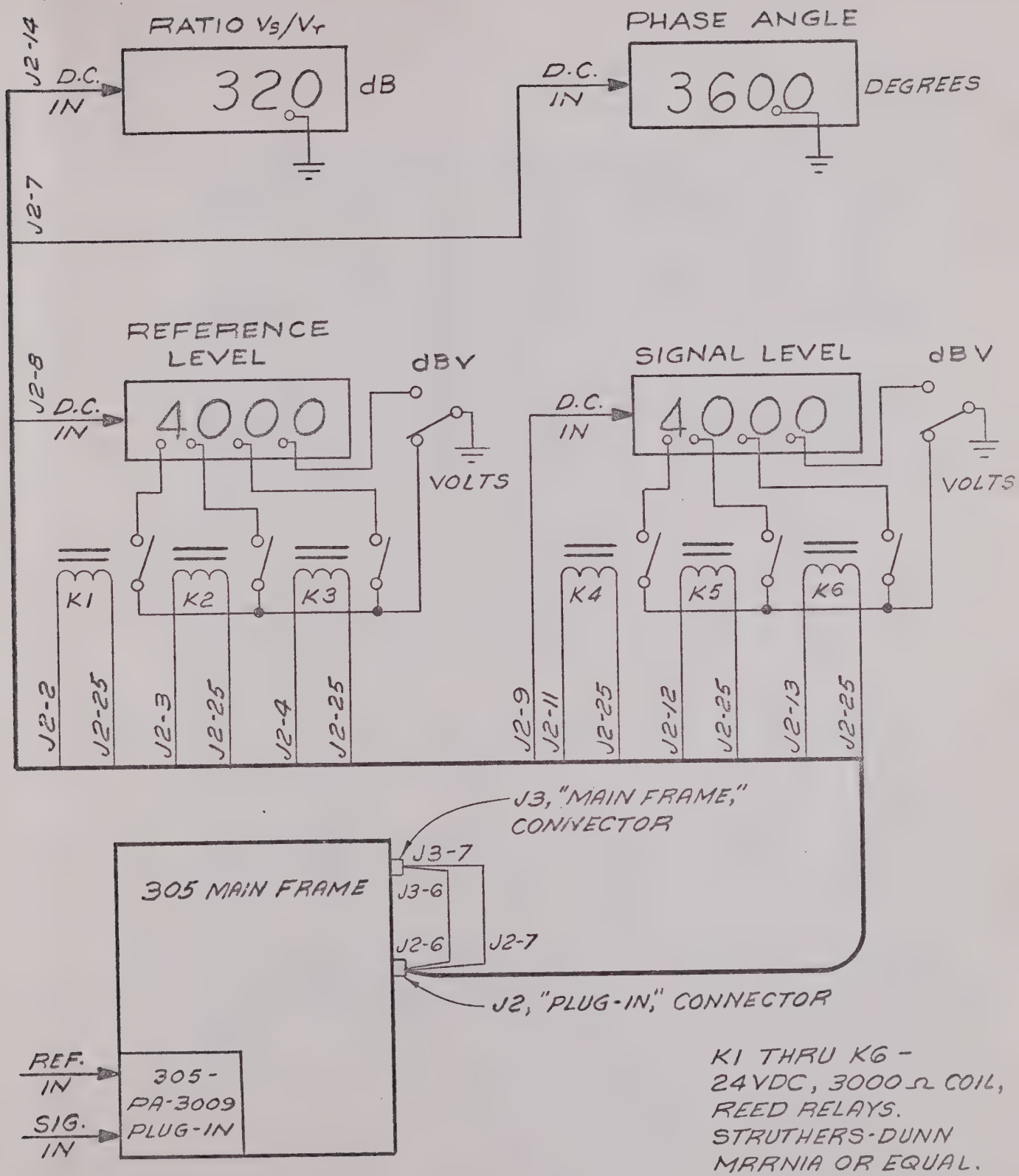


FIGURE 2-2, CONNECTION DIAG.
USING FOUR SIMULTAEOUS EXTERNAL DPMS

2.3.7 This paragraph lists in order and describes in detail the function of each of the 25 pins of the PLUG-IN CONNECTOR (J_2) on the rear of the main frame.

2.3.7.1 Pin 1 provides a TTL compatible (< 0.8 Vdc LOW, > + 2.4 Vdc HIGH) output which is high whenever both Signal and Reference inputs are within the high accuracy range of 40 mV rms to 40 V rms. This output goes low whenever either input is out of the specified limits.

2.3.7.2 Pin 2 provides a PNP transtor closure to ground when the ≤40 mV to 400 mV Reference input level range is in use. This pin can draw 8 ma dc from a 3 KΩ load connected to -24 Vdc (Pin 25). It is intended to operate a reed relay. Pins 3 and 4 provide identical outputs for the 400 mV to 4 V and 4 V to 40 Vrms input ranges.

2.3.7.3 Pins 5, 10 and 15 are circuit ground points.

2.3.7.4 Pin 6 outputs the function selected by the switch on the plug-in front panel. This is usually fed to J3 pin 6 which is the input to the 305 panel meter. It may be used to feed a remote DPM if the 305 main frame is without readout.

2.3.7.5 Pin 7 inputs the phase angle information to the selector switch. This information comes from pin 7 of main frame connector J3.

2.3.7.6 Pin 8 output is either a linear or dBV presentation of the Reference input voltage. Sensitivity in the dBV mode is 10 mV/dB referenced to 0 dB=1 Vrms. For sensitivities in the linear voltage mode see Table 2-2 and paragraph 1.3.

2.3.7.7 Pin 8 output is either a linear or dBV presentation of the Signal input voltage. Sensitivity in the dBV mode is 10 mV/dB referenced to 0 dB = 1 Vrms. For sensitivities in the linear voltage mode see Table 2-2 and paragraph 1.3.

2.3.7.8 Pin 11 provides a PNP transistor closure to ground when the 40 mV to 400 mV Signal input level range is in use. This pin can draw 8 ma dc from a 3 kΩ load connected to - 24 Vdc (Pin 25). It is intended to operate a reed relay. Pins 12 and 13 provide identical outputs for the 400 mV to 4V and 4 V to 40 Vrms input ranges.

2.3.7.9 Pin 14 provides an output proportional to the Ratio V sig/V ref.expressed in dB. The output is 0 Vdc for equal Signal and Reference inputs and may vary as much as ± 0.72 Vdc. Sensitivity is 10 mV/dB.

2.3.7.10 Pins 16, 17, 18, 19, 21, 22, 23 and 24 have no connection.

2.3.7.11 Pin 20 is + 24 Vdc output.

2.3.7.11 Pin 25 is - 24 Vdc output.

SECTION 3

THEORY OF OPERATION

3.1 GENERAL

The 305-PA-3009 plug-in has several functions. It generates two square wave output signals whose transitions correspond in time to the zero crossings of its two input sinewaves. It linearly detects each input signal and determines the correct input attennator to use in each channel. It converts the linearly detected information into dB form and it subtracts one dB output from the other to determine the dB level difference (ratio) between them.

3.2 BLOCK DIAGRAM DISCUSSION

3.2.1 The operation of the plug-in will be explained by reference to the block diagram of Figure 3-1. The Block diagram shows only one of the two identical channels (REFERENCE AND SIGNAL) contained in the plug-in. Since they are identical, discussion of one channel will be sufficient.

3.2.2 The input signal is applied through attennator Block 1. to input amplifier Block 2. The attenuator has 3 relay selected positions : ÷1,÷ 10 and÷100.

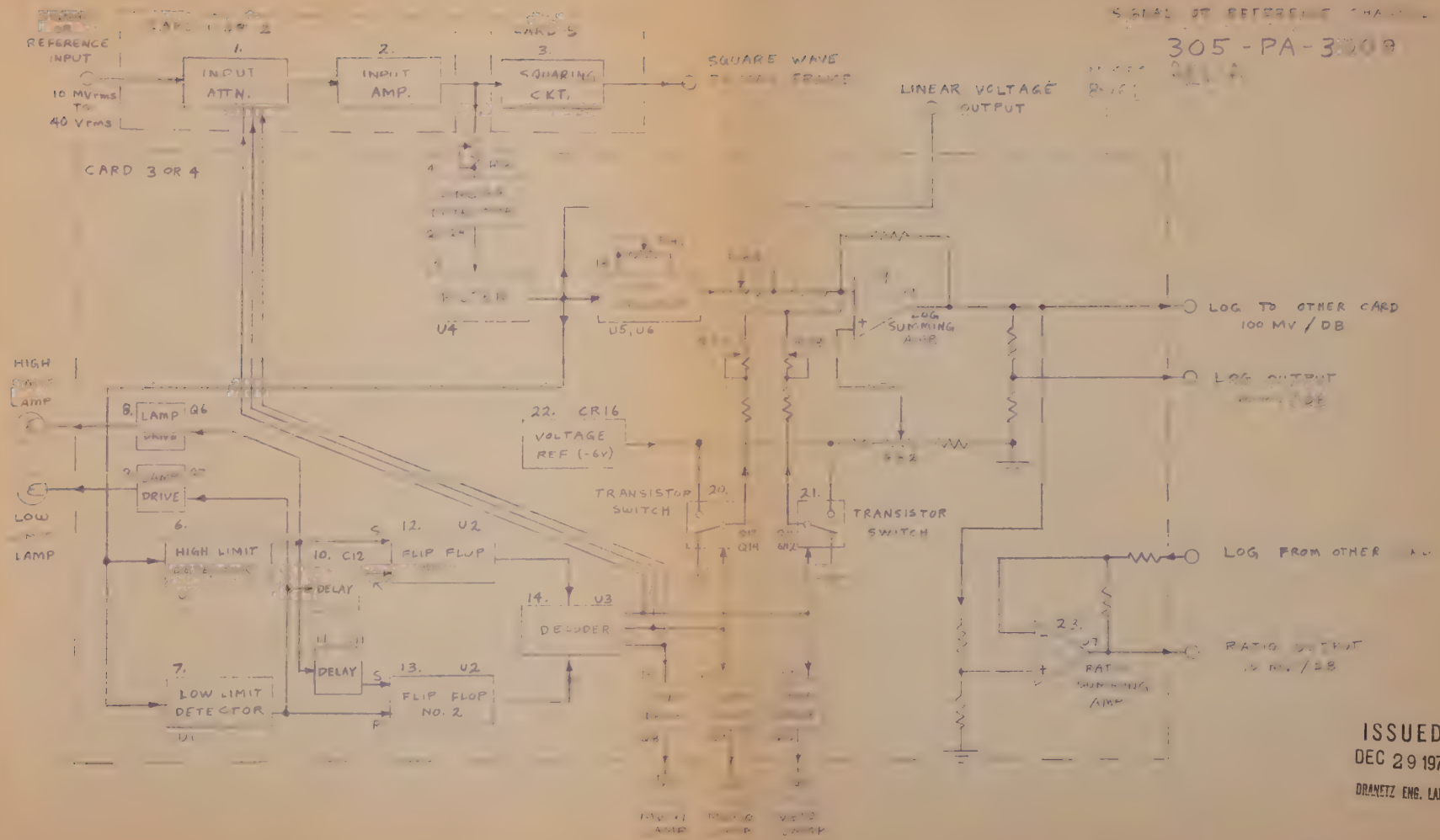
3.2.3 The output of amplifier Block 2 is applied to squaring circuit Block 3. and through gain control R3 to linear detector Block 4. The squaring circuit Outputs a square-wave to the main frame whose transistions correspond to the zero crossings of the input sinewaves.

3.2.4 The linear detector, Block 4., combined with the filter, Block 5, produce a d.c. output proportional to the amplitude of the A.C. input signal. This d.c. voltage is the "Voltage" output from the plug-in. It is also connected to the high and low limit detectors, Blocks 6 and 7.

FIGURE 3-1
BLOCK DIAGRAM

SIGNAL OR REFERENCE CHASSIS

305-PA-3[illegible]08
REV A



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3.2.5 If the input to limit detector Block 6 is greater than a preset value of approximately 3.8 volts, a negative output is produced. This output sets flip-flop Block 12 immediately. If this does not correct the high signal condition flip-flop Block 13 is also set after a time delay caused by delay Block 11.

3.2.6 If the input to limit detector Block 7 is less than a preset value of approximately 0.34 volts, a negative output is produced. This output resets flip-flop Block 13 immediately. If this does not correct the low signal condition flip-flop Block 12 is also reset after a time delay caused by delay Block 10.

3.2.7 Decoder Block 14 monitors the outputs of flip-flop blocks 12 and 13. If both flip-flops are set, the attenuator Block 1 is set at ÷100 and the V ÷10 range lamp is lit through driver Block 17. If both flip-flops are reset, the attenuator Block 1 is set at ÷1 and the MV x 1 lamp is lit through driver Block 15. If one flip-flop is set and the other is reset, the attenuator Block 1 is set at ÷10 and the MV x 10 lamp is lit through driver Block 16.

3.2.8 The output of filter Block 5, a dc voltage proportional to th amplitude of the ac input, is also connected to log convertor Block 18. The output of Block 18 is proportional to the log of its input and, when scaled properly, represents dB changes in the applied voltage. R41 adjusts the dc offset of the input stage of the Log Convertor in order to maintain accuracy at low input levels.

3.2.9 A composite analog output signal corresponding to the ac input to Block 1 is generated by log summing amplifier Block 19. This amplifier sums the output of the log convertor with 2 additional signals representing the level range in use. Since the input attenuator has 3 different positions differing by 20 dB (10:1) the amplitudes of the signals summed with the output of the log convertor are set to represent 20 dB. These signals are generated by transistor switch Blocks 20 and 21. The levels of these inputs are set by variable resistors R79 and R73 while the level of the signal from the log convertor itself is set by variable resistor R 80.

3.2.10 Switch Blocks 20 and 21 are controlled by the outputs of decoder Block 14. When the decoder selects the MVx 10 range, switch Block 20 is turned on and it feeds current from -6 volt reference Block 22 to log summing amplifier Block 19. When the decoder selects the V÷10 range, switch Blocks 20 and 21 are both turned on to supply current from the -6 volt reference to the log summing amplifier.

3.2.11 The output of log summing amplifier Block 19 represents dB referenced to 0 db = 1 Vrms input to Block 1. The zero point is adjusted using potentiometer R 82. The sensitivity of this output is 100 mV/dB. A resistive attenuator is used to reduce this sensitivity to 10 mV/db to comply with the input requirements of the 305 main frame panel meter.

3.2.12 The output of the log summing amplifier is also connected to the positive input of ratio summing amplifier Block 23. The negative input of the ratio summing amplifier is connected to the 100 mV/dB log output from the opposite channel. The output of the ratio summing amplifier is then the ratio of the plug-in's two input levels expressed in dB.

SECTION 4

PERFORMANCE CHECK

4.1 GENERAL

The performance check procedures enable the operator to determine if the 305-PA-3009 Plug-in is operating properly. This check can be performed either after setting up new equipment or after a unit has been repaired. A thirty minute equipment warm-up period followed by Main Frame Calibration in accordance with paragraph 3-5 of the main frame instruction manual (TM-101378A) must precede the performance check.

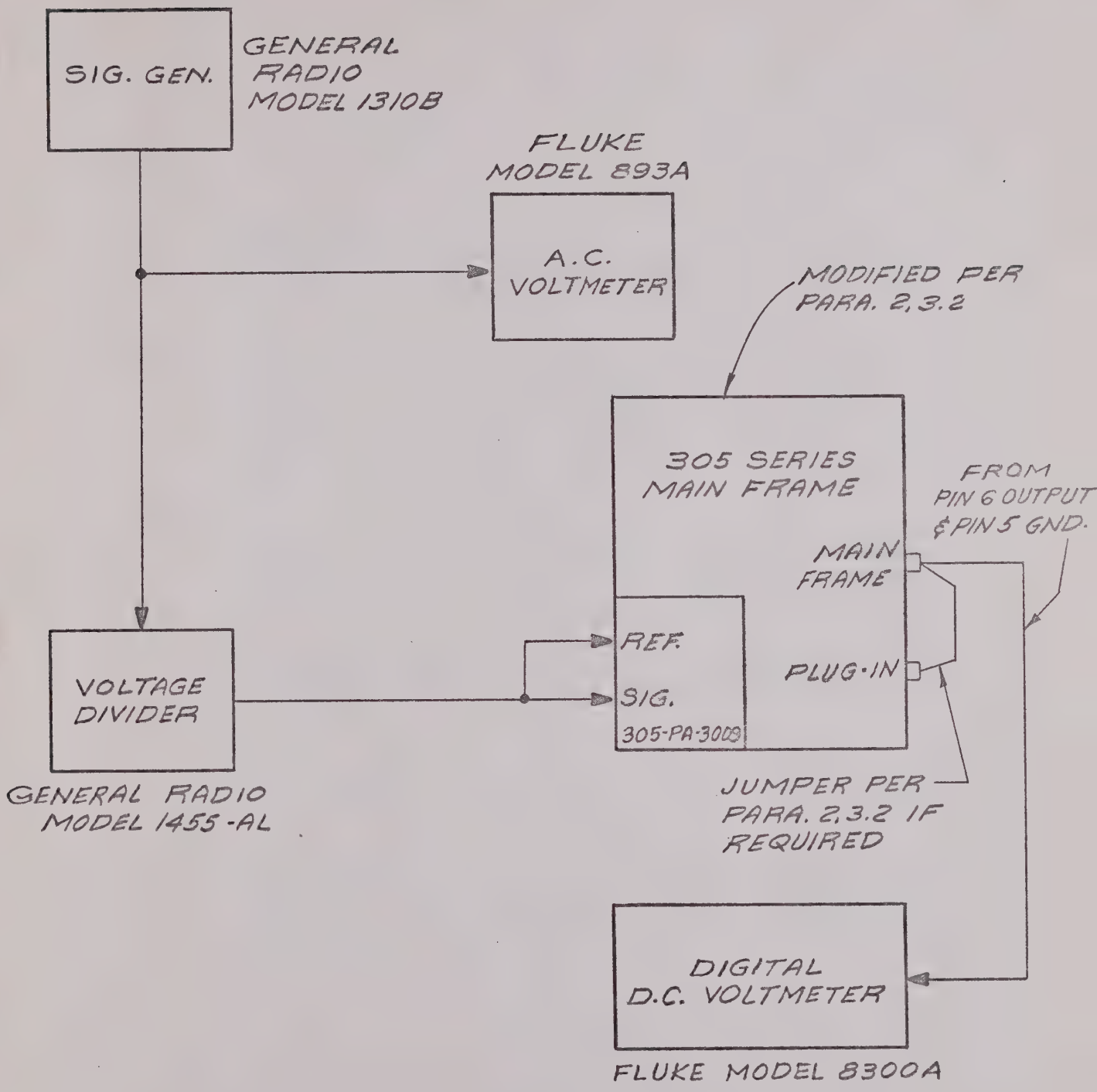


FIGURE 4-1
LINEARITY TEST CIRCUIT

4.2 TEST PROCEDURE

4.2.1 The 305-PA-3009 is tested in a series 305 main frame. Testing falls into four categories. They are level ranging, phase angle measurement, input level measurement, and ratio measurement.

4.2.2. To evaluate level ranging and phase angle measurement, conduct the test detailed by paragraphs 3-6 through 3-10 in the main frame instruction manual TM-101378A. The 305-PA-3009 should be tested as if it were a 305-PA-3001 for level ranging and phase accuracy. The 305-PA-3009 function selector switch must be in the Ø ANGLE position.

4.2.3 To evaluate input level measurement accuracy, both linearity and frequency response tests are required. Readings should be recorded in Voltage and dBV modes for both Reference and Signal Channels.

4.2.4 To measure Signal channel linearity connect the equipment as per Figure 4-1 which follows. Set the 305-PA-3009 function selector switch to the "Sig.V" position.

4.2.5 Set the signal generator output level to 10.0 Vrms at a frequency of 1.0 kHz. Maintain this voltage throughout the linearity test.

4.2.6 By varying the settings of the voltage divider, check the test points specified in the data seet of Table 4-1. Record outputs in both the Voltage and dBV modes by operating the switch on the 305-PA-3009 front panel.

TABLE 4-1

LEVEL MEASUREMENT LINEARITY DATA SHEET

Attenuator Setting V out/V in	Voltage Range	Voltage Output (Volts)	Voltage Output Limits Min.	Max.	DBV Output (Volts)	DBV Output Limits Min.	Max.
1.0000	V÷10		0.98	1.02		.197	.203
.5000	V÷10		0.49	0.51		.137	.143
.2000	mVx10		1.96	2.04		.057	.063
.1000	mVx10		0.98	1.02		-.003	+.003
.0500	mVx10		0.49	0.51		-.063	-.057
.0200	mVx 1		1.96	2.04		-.143	-.137
.0100	mVx 1		0.98	1.02		-.203	-.197
.0050	mVx 1		0.49	0.51		-.263	-.257
.0020	mVx 1		0.19	0.21		-.346	-.334
.0010	mVx 1		.090	.110		-.410	-.390

4.2.7 To measure Reference channel linearity all connections remain as in Figure 4-1. Set the 305-PA-3009 function selector switch to the "REF.V" position. Continue to maintain the 1.0 kHz signal generator output voltage at 10.0 Vrms during the balance of the linearity testing.

4.2.8 Check Reference channel linearity by again varying the settings of the voltage divider as detailed by Table 4-1. Record outputs in both Voltage and dBV modes by operating the switch on the 305-PA-3009 front panel.

4.2.9 To check level measurement frequency response connect test equipment as detailed by Figure 4-2.

4.2.10 An input level of 1 Vrms must be maintaned constant at all frequencies using the Ballantine A.C. voltmeter. Data should be recorded for both Reference and Signal channels at each frequency specified in the data sheet of Table 4-2. The VOLTS/DBV switches are kept in the VOLTS position during the entire test while the function selector switch is moved between the REF V and SIG. V positions at each frequency in order to test both channels. The error limits specified include the tolerance of the Ballantine A.C. voltmeter.

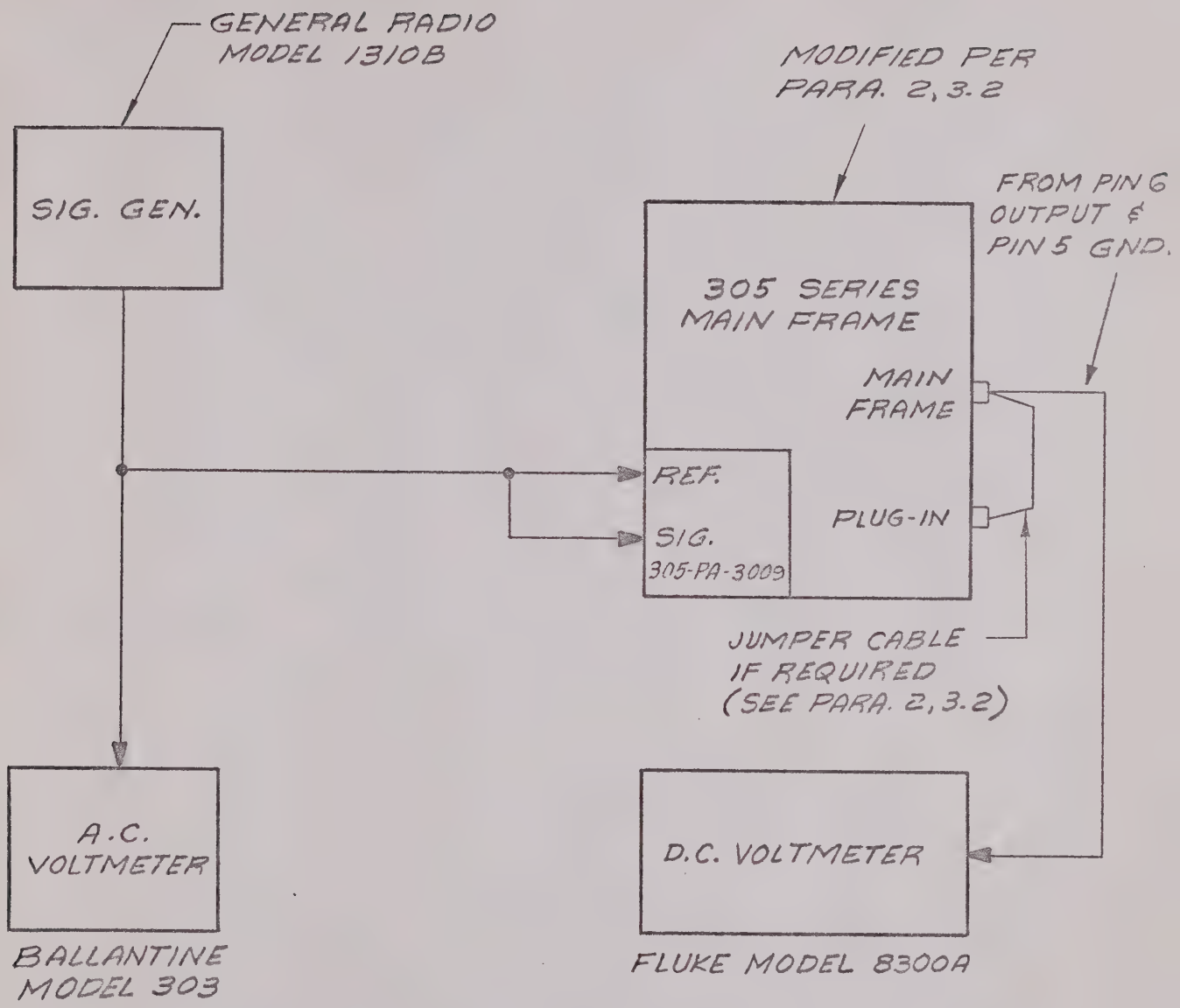


FIGURE 4-2
FREQUENCY RESPONSE TEST CIRCUIT

TABLE 4-2

FREQUENCY RESPONSE DATA SHEET

(LEVEL MEASUREMENT)

Frequency HZ	Input Level Vrms	Ref V Output V dc	Sig V Output V dc	Output Limits V dc MIN.	MAX.
10	1.00			0.92	1.08
50	1.00			0.97	1.03
100	1.00			0.97	1.03
500	1.00			0.97	1.03
1K	1.00			0.97	1.03
5K	1.00			0.97	1.03
10K	1.00			0.97	1.03
50K	1.00			0.97	1.03
100K	1.00			0.93	1.07
500K	1.00			0.90	1.10

SECTION 5

MAINTENANCE

5.1 GENERAL

No routine scheduled maintenance is required by the 305-PA-3009 plug-in. If it is desired at any time to verify the performance of the plug-in, a test may be run in accordance with paragraph 4.2. If any out of tolerance operation is noted, adjustment should be performed in accordance with paragraph 5.2. If adjustment is not adequate to correct the problem, repair may be made using the schematic diagrams along with the information contained in Section 3 and paragraph 5.3.

5.2 ADJUSTMENT PROCEDURE

5.2.1 There are twelve internal adjustments concerned with phase angle measurement in each 305-PA-3009 plug-in. These must be set correctly before adjustments concerned with level measurement are made. 5 adjustments are used to match each set of input attenuators and 1 adjustment is used to adjust each squaring circuit for minimum level sensitivity.

5.2.2 The input attenuators and the squaring circuits used in the 305-PA-3009 are nearly identical to those used in the 305-PA-3001. Adjustment procedures applicable to the 305-PA-3001 are also correct for the 305-PA-3009. These procedures are detailed in Section VI of the main frame instruction manual TM-101378A. The 305-PA-3009 function selector switch must be in the Ø ANGLE position during all adjustments concerned with phase angle measurement.

5.2.3 There are twelve internal adjustments in the 305-PA-3009 which are concerned with input level measurements. Six potentiometers on Card 4 (Bottom Card) are for the Signal input and the six potentiomets on Card 3 (2nd from bottom) are for the Reference input. The pots are all screwdrive adjustment types and are accessable from the sides of the plug-in. Refer to P.C. Board Assembly, drawing number 102, 253 to locate the various pots. Since access to the sides of the plug-in is required, it must be operated on the plug-in extender cable during this portion of the adjustment procedure. This extender is supplied with each Series 305 main frame.

5.2.4 Connect the equipment as detailed by Figure 5-1. Energize all equipment and allow a 15 minute minimum warm-up before proceeding.

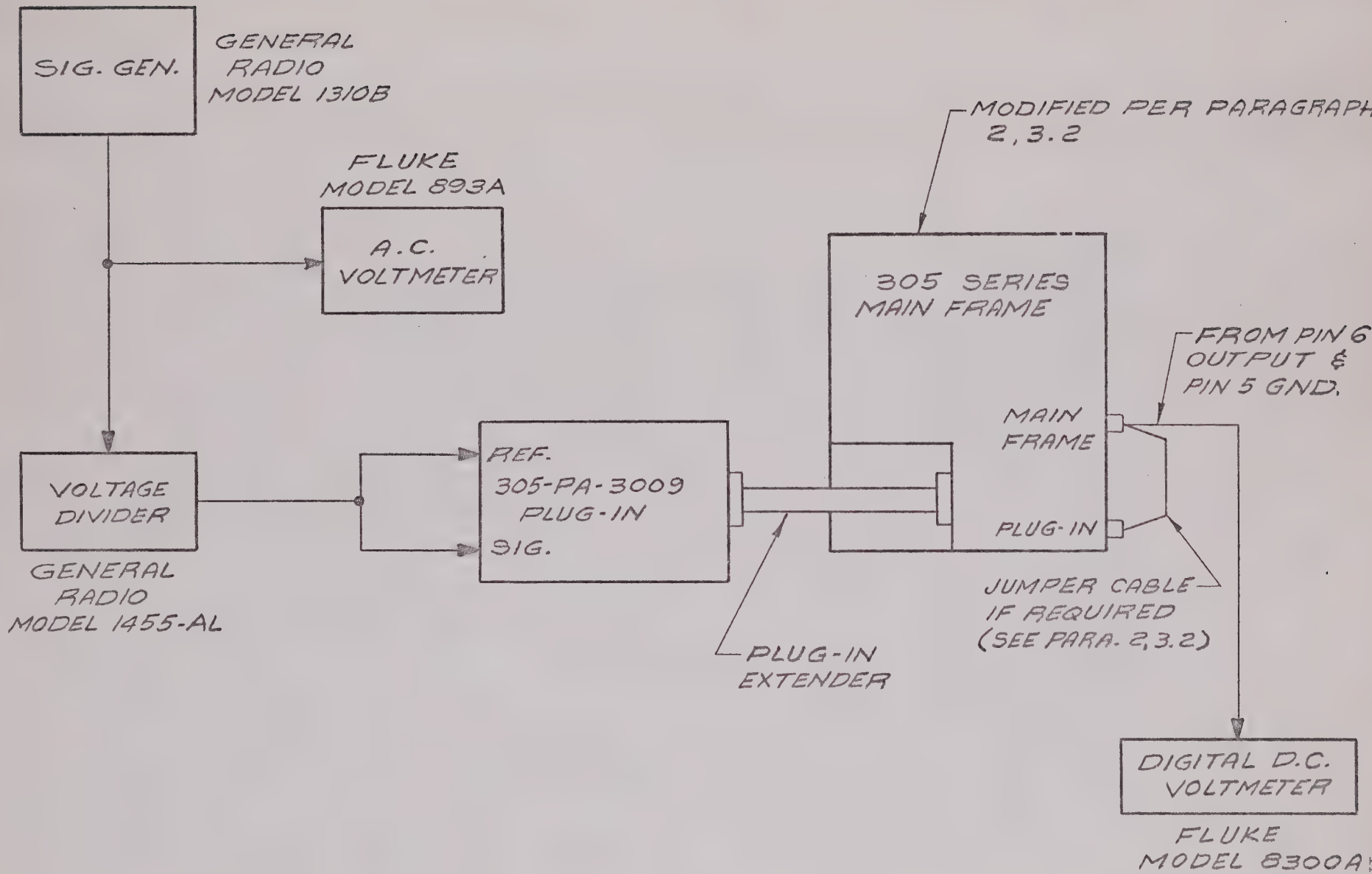


FIGURE 5-1 TEST CIRCUIT

TM-102,848

5.2.5 Adjust the Reference Channel level measurement circuits as follows using the potentiometers located on Card 3 (2nd card from bottom).

a. Set signal generator output level to 10.00 Vrms at 1 kHz. Maintain this level constant during the entire procedure.

b. Set the 305-PA-3009 function selector switch to the "REF V" position.

c. Set the VOLTS/DBV switch to the VOLTS position.

d. Set the voltage divider to .0300 (0.3 Vrms. Output).

e. Adjust R3 for a reading of 3.00 Vdc on the D.C. voltmeter.

f. Move the VOLTS/DBV switch to the DBV position.

g. Switch the voltage divider between .0090 and .0900 (0.09 and 0.90 Vrms outputs) and note the reading of the D.C. voltmeter at both settings. Adjust R79 until a difference of 200 mv (20db) between the two readings is obtained. Clockwise rotation increases difference.

h. Switch the voltage divider between .0090 and .9000 (0.09 and 9.0 Vrms outputs) and note the reading of the D.C. voltmeter at both settings. Adjust R73 until a difference of 400 mv (40db) between the two readings is obtained. Clockwise rotation increases difference.

i. Switch the voltage divider between .2000 and .2518 (2,000 and 2,518 Vrms outputs) and note the reading of the D.C. voltmeter at both settings. Adjust R80 until a difference of 20 mv (2db) between the two outputs is obtained. Clockwise rotation increases difference.

j. Set the voltage divider to .0100 (0.100 Vrms out). Adjust R82 for a reading of -0.200 Volts (-20dBV) the D.C. voltmeter.

k. Set the voltage divider to .0010 (10 mv rms out). Adjust R41 for a reading of -0.400 Volts (-40 dBV) on the D.C. voltmeter.

l. Repeat steps j. and k. until both readings are correct without further adjustment of the potentiometers.

m. Make the voltage divider settings in Table 5-1 and read the D.C. output at each input. If the output voltages do not fall within the specified limits, repeat from step a. once. If the voltages still are out of limits repair is required.

TABLE 5-1
DBV OUTPUT CHECK

Voltage Divider Settings	Required output Millivolts
.999X	+200 ± 3
.3162	+100 ± 3
.1000	0 ± 3
.0316	-100 ± 3
.0100	-200 ± 3
.0050	-260 ± 3
.0010	-400 ± 4

5.2.6 Adjust the Signal Channel level measurement circuits, using the potentiometers on Card 4 (bottom card). The procedure is identical to that used for the Reference Channel (Paragraph 5.2.5) except the function selector switch must be kept in the "SIG V" position during the adjustments.

5.3. REPAIR PROCEDURE

5.3.1 When a problem develops that cannot be corrected by adjustment, repair is necessary. If adequate facilities or trained personnel are not available, the plug-in should be returned to Dranetz Engineering Laboratories Incorporated, 2385 South Clinton Ave., South Plainfield, New Jersey, 07080 for repair. Detailed information as to the nature of the problem as well as the name of the person to contact in case of questions should be included with the unit when it is returned.

5.3.2 Where the user elects to do his own repair, a signal tracing trouble shooting technique is recommended. The block diagram and theory of operation in Section 3 give the repairman an overall view of the plug-in's operation. Details are supplied by the schematic diagrams and assembly drawings included in Section 6 of this manual and in the main frame manual TM-101378A.

5.3.3 It is sometimes necessary to perform the adjustment procedure of paragraph 5.2 following a repair since component changes may influence the settings of various adjustment capacitors and potentiometers.

SECTION 6

MAIN FRAME MODIFICATION

6.1 PURPOSE

The purpose of this section is to detail a modification which may be made to existing Dranetz Series 305 main frames to provide for more convenient use with the model 305-PA-3009 plug-in. This modification will become a standard feature of newer series 305 main frames. This modification adds a switch which will allow the use of either a 305-PA-3009 or another plug-in without changing jumper wires between rear panel connectors. The change is not necessary unless plug-in types are to be changed. If only a 305-PA-3009 is to be used in the main frame, the procedure described in paragraph 2.3.2 would probably be most convenient.

6.2 MODIFICATION PROCEDURE

6.2.1 The following steps describe in detail the operations necessary to install the toggle switch supplied (C&K type 7201 or equal) in the rear panel of a Dranetz series 305 main frame.

6.2.2 Remove the cover from the unit (2 screws at lower rear).

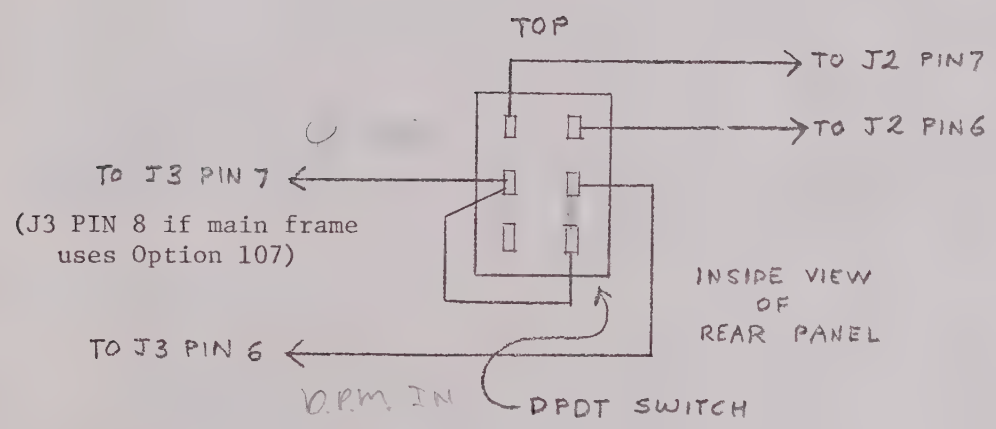
6.2.3 Keeping the unit horizontal, carefully drill a ¼" diameter hole in the rear panel. The hole should be mid-way between the"PLUG-IN" and "MAIN FRAME" connectors and approximately 1½ inches from the top of the panel. Care should be taken to keep the instrument free from chips which could cause short circuits.

6.2.4 Install the switch in the hole so the toggle operates up and down.Identify the toggle up position as "NORMAL" and the toggle down position as "3009".

6.2.5 Remove the jumper wire between pins 6 and 7 of the MAIN FRAME connector (j3). (Between pins 6 and 8 if main frame has Option 107.) AUTO CAL

6.2.6 Wire the switch as illustrated in Figure 6-1 which follows:

FIGURE 6-1
SWITCH WIRING DIAGRAM



6.2.7 Re-install 305 main frame cover using 2 screws at lower rear.

6.2.8 The unit is now ready to operate with either a 305-PA-3009 or other plug-ins. When using a 305-PA-3009, lower the toggle to the "3009" position. When using a different plug-in, raise the toggle to the "NORMAL" position.

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WARRANTY

All Products of Dranetz Engineering Laboratories, Inc., are warranted against defective material and workmanship for a period of one year from the date of delivery. Dranetz Engineering Laboratories, Inc. will repair or replace all defective equipment returned to it during the warranty period, without charge provided there is no evidence that the equipment has been mishandled or abused.

Before returning any equipment under warranty: Check with factory representative for special instructions.

RETURNED MATERIAL AUTHORIZATION

NOTE: This completed form must accompany shipment. Date _____

Date of original purchase: month _____ year _____ Original P.O. No. _____

Customer ship Prepaid to:

Dranetz Engineering Laboratories, Inc.
2385 South Clinton Avenue
South Plainfield, N.J. 07080

Return to:

_____
_____
_____

Ship via _____

Description of returned instrument:

Model No. _____ Serial No. _____

Model No. _____ Serial No. _____

Reason for return (specify malfunction in detail)

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Telephone No. _____ Signature _____

Complete and exact malfunction information will expedite return of unit

CATALOG H

DRANETZ

PRECISION INSTRUMENTATION for

PHASE/GAIN

IMPEDANCE

CURRENT

VOLTAGE

QUALITY FACTOR Q

TIME/FREQUENCY

POWER LINE DISTURBANCE

INTRODUCTION

DRANETZ ENGINEERING Laboratories, Inc. is a leader in the design and manufacture of precision AC test instruments and systems. This equipment is widely used for measurement of impedance, admittance, transfer function, voltage, current and phase.

THIS CATALOG contains complete descriptions and specifications on many Dranetz instruments. With current price lists, this information is sufficient for specifying and ordering equipment. Additional information is often available, including application notes as well as Bulletins describing specific instruments and systems. These can be obtained by contacting our main plant or your local field representative.

DRANETZ EQUIPMENT utilizes the latest developments in the electronics state-of-the-art to provide the most advanced equipment with high quality at an economical price. Each instrument utilizes the latest in solid state and microcircuit components and, where possible, uses modular design. Flexibility and versatility are designed into these instruments at their concept. Computer compatibility is often available in standard instruments, and options can be provided for special requirements. In addition, the plug-in concept of these instruments assures exceptional flexibility.

OUR HIGHLY TRAINED FIELD AND PLANT ENGINEERS are readily available to assist you or supply you with additional information to enable you to meet your specific requirements. A telephone call will bring this service to you immediately without cost or obligation.

AFTER SALE SERVICE is an important reason for purchasing Dranetz equipment. Each instrument is warranteed for 1 full year after purchase. Dranetz maintains technical field representatives throughout the U.S. and in other countries, fully backed by in-plant experts. Wherever possible, application and service problems are solved on site. In addition, the company provides prompt and immediate service for equipment returned from the field. Frequently loan equipment is available for use during equipment repair.

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For information on products assigned Federal Stock Numbers (FSN) or available on Federal Supply Schedules (GSA) please contact factory.

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SERIES 305

SUPER PERFORMANCE PHASEMETERS AND GAIN/PHASEMETERS*

305 Series Phasemeters provide the highest available accuracy, along with many operational features. Designed for the calibration laboratory, the design engineer's bench, the production line and automatic test systems, the 305 is the most widely accepted phasemeter in industrial, and governmental organizations. **

FEATURES

- No hands 86 dB dynamic range
- Automatic or programmable operation and calibration
- Highest accuracy — to 0.03°
- Repeatability better than 0.01°
- Rejects harmonics and noise
- Wide frequency range — 1 Hz to 11 MHz

FLEXIBILITY THROUGH PLUG-IN CONCEPT

The plug-in concept of the 305 offers a wide selection of characteristics. Three standard mainframes and nine plug-ins are complemented by a variety of options, such as programmability, high speed and auto-calibration. Special modifications are also available. In addition, modular construction throughout provides maintainability at both component and P.C. card levels for ease and speed of servicing.

WIDE FREQUENCY RANGE

The basic mainframe provides a direct frequency coverage of 2 Hz to 700 kHz with high accuracy. By the use of frequency converting plug-ins such as the 305-PA-3005, standard units can handle frequencies up to 11 MHz. Special units can be provided for higher frequency.

NO HANDS OPERATION

The Series 305 Phasemeters require no controls or adjustments by the operator. These units are also equipped with several significant automatic features. These include automatic selection of angle range, automatic sensing of leading or lagging angle, automatic selection of the output time constants, and automatic setting of AC gains.

HIGHEST ACCURACY

Accuracy to better than ±0.03° is attained with precision mainframes and carefully designed plug-ins. Mainframes exhibit precise zero crossing detection, angle-to-DC conversion linearity to approximately ±0.01° and outstanding DC stability. Plug-ins are designed for accurate conversion of sine wave (also square wave) inputs to square waves through carefully controlled amplifier circuitry, use of gain autoranging, and harmonic filters where necessary.

INSENSITIVITY TO INPUT LEVEL

Series 305 plug-ins are available with a guaranteed accuracy of better than ±0.05° even with independent input level variations of 60 dB. Typical accuracy can approach ±0.03° as shown on the following page.

NON-AMBIGUOUS ANGLE READINGS

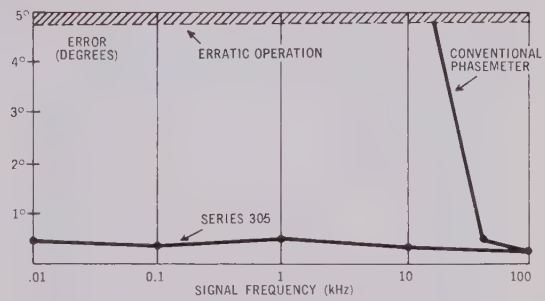
Two phase angle ranges in the 305 eliminate the ambiguity or "dead zone" error inherent in all other phasemeters (usually at 0°/360° or −180°/+180°). An automatic system switches to the 0°/360° range for angles near 180° and to the −180°/+180° range for angles near 0°. Unique guard bands prevent dead zones near switching points.

REPEATABILITY, STABILITY, AUTOCALIBRATE

Repeatability of the 305 is better than ±0.005°; temperature coefficient is ±0.001°/°C; and DC output drift is better than ±0.05° over any 30 day period. The autocalibrate feature eliminates virtually all DC errors in digital panel readout and BCD rear panel outputs.

NOISE IMMUNITY

Unique patented circuitry minimizes noise errors and makes possible accurate phase measurements under noise levels where other phasemeters become completely useless. The accompanying curve compares the phase error of the model 305 with that of a conventional phasemeter with broad band noise in both channels.



PHASE READING ERROR VS SIGNAL FREQ. FOR GAUSSIAN NOISE (FLAT TO 5 MHz) IN BOTH CHANNELS FOR S/N = 10

PROGRAMMABLE OPERATION

Standard mainframes are provided with rear connections for over-riding the automatic time constant and angle range selectors by relay contact closures. Options are provided for control by DTL and TTL logic.

DIGITAL READOUT

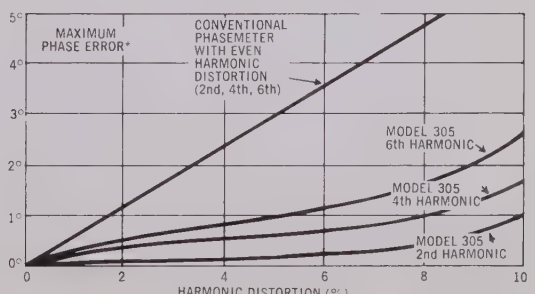
In addition to analog DC output, standard mainframes are available with up to 5 digit panel readouts (i.e., 0.00° to ±180.00° and 0.00° to +360.00°) and BCD outputs for each digit. Autocalibrate feature eliminates virtually all meter drift and scaling errors.

RAPID PHASE NULLING

For production testing of filters and other networks, an additional analog deviation-panel meter (305D) provides an easy means of adjusting a test angle to any accurate value. Presetting can be done in seconds without any other equipment. The precision digital panel meter monitors actual test angle continuously.

ABILITY TO REDUCE HARMONICS

The 305 is designed to reduce significantly the errors due to even harmonic distortion without the use of filters. The accompanying curve compares the error due to even harmonic distortion (maximized for worst case harmonic angle) on conventional phasemeters and on the model 305. (Odd harmonics in-phase with fundamental contribute no error.)



COMPARISON OF ERRORS DUE TO EVEN HARMONIC DISTORTION
(* For worst case phase relationship between harmonic and fundamental)

*Manufactured under U.S. Pat. No. 3,725,781
**For extensive application information, write for availability of "Applications Handbook of Precision Phase Measurement."

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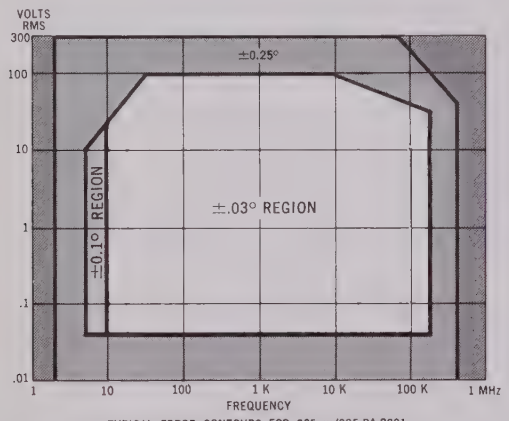
SERIES 305

SUPER PERFORMANCE PLUG-INS

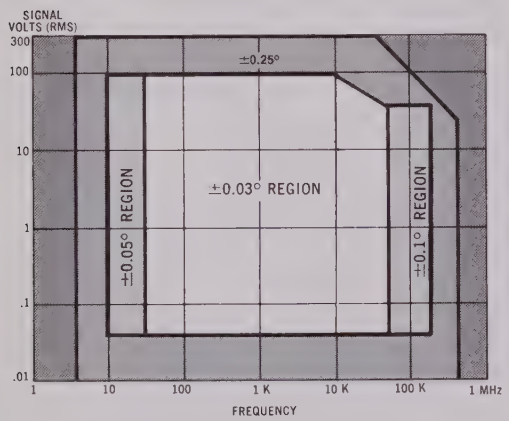
The variety of plug-ins available provides unlimited flexibility for the Series 305 Phasemeters in meeting many phase measurement problems. In addition to an expanding line of standard plug-ins, custom units can be designed for special needs.

305-PA-3001 AUTORANGING PLUG-IN

This plug-in features high accuracy over a broad range of input levels and frequencies. Autoranging of gain in each channel assures high accuracy (±0.05° guaranteed) over a dynamic range of 60 dB (50 mV to 50 V rms) for independent levels of inputs, with a useful range of 90 dB (10 mV to 300 V rms). This plug-in covers the range from 2 Hz to 700 kHz, with its highest accuracy in the 50 Hz to 50 kHz range. The curves shown illustrate typical accuracies as a function of level and frequency. The 305-PA-3001 also features compatibility with Tektronix probes and includes front panel lamps to indicate when either input signal is below 50 mV or above 50 V rms.



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001 FOR EQUAL SIGNAL INPUTS



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001 FOR UNEQUAL INPUTS — REF. 0.3 VOLTS RMS

While the above accuracies apply to sine wave inputs, this instrument can also be used for square wave and amplitude modulated signals.

305-PA-3002 SINGLE RANGE PLUG-IN

The 305-PA-3002 is similar to the model 305-PA-3001 except that it does not include autoranging or limit indicator lamps. For sine wave inputs the standard unit is designed for guaranteed ±0.05° accuracy (typically ±0.03°) over independent signal levels of 50 mV to 500 mV rms, with a slight reduction in accuracy from 10 mV to 3 V rms. Other level ranges can be supplied on special order; Tektronix probes can be used for high input levels. This plug-in is useful for sine wave, square wave and amplitude modulated signals.

305-PA-3005 HIGH FREQUENCY PLUG-IN

This high frequency plug-in is designed for high accuracy to 11 MHz. Using a self tracking oscillator, the input signals are converted to 40 kHz for precision measurement by the mainframe. Input attenuators (50 ohms) are provided with 10 dB steps, to cover a range of 1 mV to 3 V rms in either channel. Front panel lamps indicate when input levels are out of range or when level controls are improperly set. The self tracking oscillator can be controlled by channel A signal or by a third independent signal.

305-PA-3007 PROGRAMMABLE AND AUTORANGING PLUG-IN

This programmable plug-in features all of the characteristics of the model 305-PA-3001. In addition it includes increased input gain to achieve operation down to 1 mV rms. The unit can be operated either in an automatic or programmable mode. Without rear connections, the plug-in operates automatically as a 305-PA-3001; however, by utilizing rear connectors, the internal autoranging can be overridden and additional internal gain can also be inserted. Programming is available by DTL and TTL logic.

305-PA-3008 SINGLE FREQUENCY PLUG-IN

The 305-PA-3008 is a special purpose plug-in designed for precision calibration of 50 Hz, 60 Hz and 400 Hz power line equipment such as wattmeters, phase detectors and watt hour meters. This instrument can measure phase difference between two voltages, two currents or between a voltage and a current. The unit covers a voltage range of 25 V to 250 V rms and a current range of 0.1 to 5 A rms. The basic plug-in covers the frequency range of 50 Hz to 500 Hz. Plug-in filters, available for 50 Hz, 60 Hz and 400 Hz, assure reduction of second harmonic by at least 40 dB and higher harmonics by at least 50 dB. A front panel zero control provides adjustment for high accuracy (±0.1°) at any single frequency.

305-PA-3009 WIDE BAND NETWORK ANALYZER PLUG-IN (GAIN/PHASE/AMPLITUDE)

This plug-in measures the voltage amplitude of each signal input (in volts or dBV, selectable by operator), the phase difference between inputs, and the amplitude ratio of inputs. Featuring autoranging of gain in both channels, it requires no manual setting of gains for any measurement. Simultaneous DC outputs on mainframe are proportional to all four fuctions. A front panel switch selects the measuring mode for digital panel readout — channel A voltage, channel B voltage, phase difference, or amplitude ratio. Lamps on the front panel of the plug-in indicate the proper decade multiplier. The 305-PA-3009A is designed for extending the low frequency range.

305-PA-3010 SPECIAL PURPOSE PLUG-IN

This plug-in is typical of special purpose plug-ins which can be supplied to meet unique problems. Having high input impedance, it is equipped with closely matched low pass filters to pass 125 Hz signals while rejecting 400 Hz signals, solving problems in many types of servo control systems. Similar units can be readily designed for other special voltage and frequency applications.

305-PA-3015 PROGRAMMABLE PLUG-IN

Intended for use in automatic test systems, this plug-in has two selectable filters for harmonic rejection and selectable gains to handle inputs from 50 mV to 50 V rms. Filter (or filter out) selection as well as gain switching is accomplished by contact closures across terminals on the rear of the main frame.

PRECISION TRANSFORMER ISOLATION NETWORKS

Dranetz TR 3100 series networks are available for input voltage isolation with minimum phase error and flat gain response. For use with balanced or signal ended sources, these units are equipped with internal preamplifiers to produce outputs in the 30 mV to 3 V rms range (for use with 305 Series Phasemeters) for input levels from 50 mV to 500 V rms. These transformer units are packaged for direct plug-in into the input BNC's of the phasemeter, and draw B+ power from the front panel accessory connector of the phasemeter plug-in. Size: 2¾" x 2¾" x 2". Input: banana jack. Output: BNC.

Model TR____	Zin	Com. Mode Rej: >60 dB for frequency	Range for ±0.1° typical shift	Range for ±0.3° typical shift	Gain ±2%
3101	1 megΩ 70 pF	Below 1 kHz	20-400 V rms 50 Hz-20 kHz	5-400 V rms 10 Hz-25 kHz	x 0.01
3102	100 kΩ 70 pF	Below 10 kHz	2-40 V rms 50 Hz-20 kHz	0.5-40 V rms 10 Hz-25 kHz	x 0.1
3103	10 kΩ 70 pF	Below 25 kHz	0.2-4 V rms 50 Hz-20 kHz	0.05-4 V rms 10 Hz-25 kHz	x 1.0

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SERIES 305

SUPER PERFORMANCE PHASEMETERS

MAINFRAME SPECIFICATIONS

Frequency Range: 2 Hz to 11 MHz (see plug-in data)

Angle Ranges: 0.00° to ±180.00° or 0.00° to +360.00° manually or automatically selected. End-of-range measurement errors are prevented by 15° automatic guard zones.

Analog Output

Range: −1.8000 to +3.6000 Vdc corresponding to measured angle; 10.0 mVdc per degree

Accuracy: See plug-in specifications

Output Impedance: 100 ohms

DC Resolution: Infinite

Linearity: Approx. ±0.01°

Repeatability: Better than ±0.005°

Time Constants: Automatically selected; 10 ms for frequency >5 kHz, 50 ms >500 Hz, 350 ms >50 Hz, 700 ms >2 Hz (Note: 4.6 time constants to respond to better than 99% of step change).

Warm-up Drift: Approx. 0.05° after first minute.

Long Term Drift: Typically less than ±0.05° per month

Temp. Coefficient: Approx. ±0.001°/°C

Recommended Output Devices: Recorders, DVM's, A-D Converters, Printers

Self Check: Front panel switches; dc outputs correspond to −180.00°, 0.00°, +180.00° and +360.00°

Error Rejection: False triggers due to high frequency noise are locked out for signal to noise ratios better than 10:1. Errors and fluctuations due to waveform dissymmetry or low frequency noise reduced by at least 10 to 1.

Harmonic Rejection: Worst case errors due to even harmonic distortion reduced by approximately 5:1 without filters. Odd harmonics in-phase with fundamental contribute no error.

Operator Adjustments: None.

Operating Temp. Range: 0° to +50°C

Grounding: Independent grounds for signal, chassis, and power line. (For safety, chassis and power line grounds connected at factory.)

Remote Programmability (standard on all mainframes): By rear connector pins. Override by contact closure of automatic time constant selection and angle range. Factory installed wiring from rear connector to plug-in for use with programmable plug-ins.

Modular Construction: Circuits on removable plug-in cards, extenders supplied for ease in servicing.

Size: 3½" high, 16" deep, 19" rack/portable package; shipping 22½" x 22½" x 6½".

Weight: 20 lbs. (9 kg.); shipping 30 lbs. (14 kg.).

Power: 115/230 V, 50-400 Hz, <0.75 A (specify voltage and frequency when ordering).

Plug-In Accommodation: Accepts 305-PA-( ) plug-ins. Mainframes and plug-ins are interchangeable.

ANGLE PRESENTATION

	Model 305	Model 305B	Model 305C	Model 305D
DIGITAL				
Display	None	4 digit plus sign	5 digit plus sign	
Angle Ranges	Not Applicable	0.0° to ±180.0° and 0.0° to +360.0°	0.00° to ±180.00° and 0.00° to +360.00°	
Resolution	NA	0.1°	0.01°	
BCD Output	None	BCD coded (1248), 4 lines per digit plus polarity line; TTL/DTL compatible (<0.8 V to > +2.4 V dc). Read and hold on command, and data ready features available on rear connector.		
Warm-up Time	NA	30 minutes (1 minute with option 107)		
Zero & FS Controls	NA	Front panel for FS & 0 (no adjustments with option 107)		
ANALOG				
DC Output	10.0 mV/°; 0.0000 V to 3.6000 V and −1.8000 V to +1.8000 V corresponding to 0.00° to 360.00° and −180.00° to +180.00°; infinite resolution.			
DC Offset	None			Continuously adjustable angle offset. Analog panel meter and DC output indicate deviation from offset.

OPTIONS

#101 Rear connectors for signal and reference inputs, BNC[4]

#102 Full mainframe programmability; includes self check, angle range and time constant selection, DTL and TTL compatible.

#103 High speed analog output response. Time to respond to within 99% of step change: 1 ms for frequency >5 kHz, 10 ms >500 Hz, 100 ms >50 Hz, 1 second >5 Hz. (Temp. stability ±0.01°/°C)

(Opt. 103 not available with Opt. 107 or Mod. 14 below.)

#105 Remote zero control.

#107 Automatic calibration checks and automatically readjusts digital readout and BCD output circuits to reduce readout errors to ±0.02°. This option available only on 305C.

Mod. 14 Higher accuracy below 12 Hz. Available only on 305B, 305C, and 305D.

COMBINED PLUG-IN AND MAINFRAME SPECIFICATIONS

MODEL	FREQUENCY RANGE	INPUT LEVELS (independent)	INPUT Z	ACCURACY[2] WITH INDEPENDENT LEVELS UNLESS OTHERWISE INDICATED **Analog output accuracy: As specified below.** **Digital phase accuracy: For model 305C, same as analog accuracy. For model 305B, add ±0.15° digital readout error to analog accuracy specified.**
305-PA-3001 Auto Ranging Plug-in	2 Hz to 700 kHz	10 mV to 300 V rms up to 10 kHz and to 50 V rms up to 700 kHz; can be extended to 40 kV rms with Tektronix probes. Each channel has automatic gain ranging, and lamps which indicate when level is below 50 mV and above 50 V rms.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 50 V rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 50 V rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3002 Single Range Plug-in	2 Hz to 700 kHz	10 mV to 3 V rms[1]; can be extended to 3 kV rms with Tektronix probes. Other ranges available on request.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 500 mV rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 500 mV rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3005 High Frequency Plug-in	200 kHz to 11 MHz	1 mV to 3 V rms; manual level controls in 10 dB steps. Lamps indicate when inputs are out of range or when level controls are improperly set.	50 ohms	Broadband with equal inputs above 10 mV rms: ±0.4° from 200 kHz to 4 MHz; ±1° from 4 MHz to 11 MHz. With independent levels above 10 mV rms: ±1° up to 4 MHz and ±2° up to 11 MHz. Single frequency — above 10 mV rms: ±0.3° at any frequency from 200 kHz to 11 MHz at any fixed levels.
305-PA-3007 Programmable and Auto-Ranging Plug-in	2 Hz to 700 kHz	Autoranging: similar to levels of 305-PA-3001. Programmable: overrides autoranging; extends low levels to 1 mV rms; DTL, TTL logic; program connector in rear of mainframe.	1 megohm shunted with 40 pF	Same as 305-PA-3001 for levels above 10 mV rms; typically ±0.35° from 50 Hz to 50 kHz for levels below 10 mV rms.
305-PA-3008 Power Freq. Plug-in	50-500 Hz without filters. 50 Hz, 60 Hz and 400 Hz L.P. filters available[3]	25 V to 250 V rms; 0.1 A to 5 A rms. Inputs are transformer isolated.	100 k ohm (voltage) 0.02 Ω max. (current)	At any single frequency, with filter set: ±0.1°, 25 V to 250 V rms, or 0.1 A to 5 A rms.
305-PA-3009 Network Analyzer (Gain/Phase/ Amplitude)	5 Hz to 700 kHz (Note: 305-PA-3009A operates to 1 Hz with 305 mod. 14)	10 mV to 40 V rms. Each channel has automatic gain ranging. Direct reading of phase angle, amplitude ratio and level of each input. Compatible with Tektronix probes.	1 megohm shunted with 40 pF	Phase: ±0.1° from 40 mV to 40 V rms from 50 Hz to 50 kHz; typically ±0.25° at all other levels from 5 Hz to 500 kHz. Voltage Amplitude: above 40 mV (channel A or B): ±2% reading ±0.03% FS, 50 Hz to 50 kHz; ±5% reading ±0.03% FS, 100 kHz to 500 kHz.[5] Ratio: ±0.5 dB, 50 Hz to 50 kHz; ±1 dB, 50 kHz to 500 kHz.[5]
305-PA-3010 Special Purpose Plug-in (with filter)	For use at 125 ±10 Hz; matched filters in both channels reject higher frequencies	500 mV to 5 V rms. Other ranges available on request.	1 megohm shunted with 40 pF	±0.1°, 500 mV to 5V rms; ±0.25°, 100 mV to 500 mV rms.
305-PA-3015 Selectable Filter Plug-in	5 Hz to 500 kHz without filters; uses 2 of type 305-PA-3008-( ) filters [3]; filter selection programmable	Ranges of 50-500 mV rms, 0.5 to 5 V rms, and 5-50 V rms selectable by remote contact closures.	1 megohm shunted with 40 pF	With filters, ±0.1° at fixed frequencies over all levels; without filters ±0.1° from 50 Hz to 50 kHz at all levels (typically ±0.03°), typically ±.25°, 5 Hz to 500 kHz.

[1] Can be provided for other voltage levels.

[2] For sinusoidal signal; can be used for square wave inputs over limited frequency range; can be used for amplitude modulated signals up to 97% modulation, depending upon model, level and frequency.

[3] 50 Hz filter, P/N 305-PA-3008-50; 60 Hz filter, P/N 305-PA-3008-60; 400 Hz filter, P/N 305-PA-3008-400. (Other frequencies available on request.)

[4] Available for use with 305-PA-3001, -3002, -3007 and -3010. Specify when ordering plug-in.

[5] For higher accuracy below 50 Hz, specify Model 305-PA-3009A.

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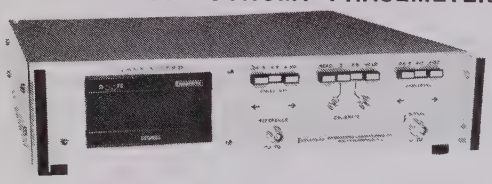
SERIES 331

HIGH ACCURACY ECONOMY PHASEMETERS



- Accuracy to 0.05°, resolution to 0.01°
- Frequency range 2 Hz to 500 kHz
- Analog output and 4 or 5 digit panel readouts
- Input 0.05 to 220 V rms
- Accepts sine, square and other waveforms in either channel

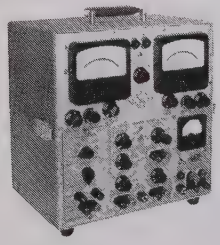
The Dranetz 331 Series Phasemeters feature high accuracy over a broad amplitude and frequency range. Front panel controls (equipped with LO/HI indicators) are used to select proper voltage ranges, as well as to check and adjust calibration. The 331 incorporates several of the important features of the Superperformance 305 Series, including elimination of 0°/360° ambiguity and reduction of sensitivity to noise and even harmonics. The 331 is designed for calibrating equipment, for testing subassemblies and for general laboratory work.

SPECIFICATIONS

CHARACTERISTICS	331B	331C
Frequency Range:	2 Hz to 500 kHz	
Accuracy: Sine Wave:	±0.1° ±1 digit from 50 Hz to 50 kHz, add ±0.2° per 100 kHz above 100 kHz and ±0.2° ±1 digit at 5 Hz.	±0.05° from 50 Hz to 50 kHz; ±0.2° from 10 Hz to 100 kHz; add ±0.2° per 100 kHz above 100 kHz.
Square Wave:	±0.1° ±1 digit from 10 Hz to 20 kHz; ±.5° per 100 kHz above 20 kHz	±0.05° from 10 Hz to 5 kHz; ±0.1° to 20 kHz; ±0.5° per 100 kHz above 20 kHz.
Angle Ranges:	000.0° to 360.0° or −180.0° to +180.0° automatic or selectable.	
Display:	Beckman (Sperry) 0.6″ 4 digit for ranges above.	Beckman (Sperry) 0.6″ 5 digit for ranges above.
Drift (30 day period): Sine Wave: Square Wave: DC Drift:	None None 0.1°	
Repeatability (DC):	Better than 0.1°.	Better than 0.01° after readjusting 0 and FS.
Temperature Coefficient:	0.01°/°C independent of other conditions.	
Input Signal Amplitudes:	0.05 to 220 Volts rms in 3 ranges (0.05-0.5, 0.4-5, 4-220; can be extended with Tektronix probes.	
Input Impedance:	1 megohm shunted by 50 pF nominal	
Response Time:	700 milliseconds	
Maximum DC Component:	±200 volts; can be extended with probes	
Analog Output:	0.0000 to 3.600 V and −1.8000 to +1.8000 V DC, +10.00 mV DC/degree phase; output impedance less than 100 ohms.	
Ambient Temperature	0°C to 45°C	
Panel Controls and Adjustments:	3 range input level pushbuttons each channel; read-hold; power; 0° cal and 360° cal adjustments.	
Connectors:	BNC, both input channels, rear and front; PC rear for analog output.	
Power Requirements:	105-125 or 210-250 volts, 50/60 Hz, 70 watts.	
Dimensions:	3½″ high x 16″ deep, 19″ rack/portable package; 22½″ x 22½″ x 6½″ shipping; 18 lbs. (7 kg) net wt., 25 lbs. (10 kg) shipping.	
Option:	#101: BCD output, TTL/DTL, 8421	#101: BCD output, TTL/DTL, 8421

SERIES 100 NETWORK ANALYZER

COMPLEX IMPEDANCE, ADMITTANCE AND TRANSFER FUNCTION METERS



APPLICATIONS

- Production Testing
  Capacitors, inductors, transformers
- Linear Network Design
  Filters, amplifiers, linear IC's
- Acoustic and Electromechanical Analysis
  Transducers, arrays, interacting fields
- Linear and Non-linear Device Design
  Piezoelectric, dielectric, magnetic devices

MEASURE... RECORD... PLOT...

$$Z = R + jX = |Z| \angle\theta z \qquad Y = G + jB = |Y| \angle\theta y$$

$$\frac{V_0}{V_1} = \left|\frac{V_0}{V_1}\right| \cos\theta + j \left|\frac{V_0}{V_1}\right| \sin\theta = \left|\frac{V_0}{V_1}\right| \angle\theta$$

These instruments provide rapid measurements of impedance, admittance and transfer function parameters. Panel meters give direct reading, and DC outputs are used for frequency plots. Consisting of 100C main frame and choice of plug-in, the instrument is exceptionally flexible. Plug-in 100-PA-1001A is used for both impedance and admittance* measurements. 100-PA-1008 is for differential admittance measurements, to improve accuracy of minor components.

PLUG-INS

Model 100-PA-	Measures	Frequency Range	Linear Ranges, Full Scale 1, 2.5, 5, etc. Sequence	Voltage Across or Current Through Unknown (RMS)
1001A	Z & Y	100 Hz to 200 kHz	10 Ω to 50 kΩ 10 μ℧ to 50 k μ℧	0-45 mV in Z mode; 3 V in Y mode
1008	Y or △ Y*	100 Hz to 100 kHz	100 μ℧ to 500 m ℧	3 V

For further details on Series 100 write for Bulletin 100, TP102983, and TP102982.
Patents #3,267,355 and #3,275,933.

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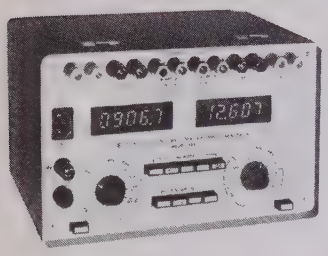
SERIES 325

POWER SYSTEM POLYMETER / DUAL MEASUREMENT OF VOLTAGE, CURRENT, TIME, FREQUENCY



FEATURES

- Simultaneous measurement and display of two selectable parameters.
- Display of continuous, triggered or maximum readings.
- Full isolation of all inputs.
- Precision measurement of time interval in seconds or cycles.
- Large 0.6″ digital display.
- Precision frequency measurement optional.
- Portable for field use.
- A field instrument with laboratory accuracy.

The Series 325 is specifically designed for measuring key parameters in electric power systems. Simultaneous measurements of Voltage and Current, 2 Currents, 2 Voltages, Current and Time, and Voltage and Time may be made. Readings may be taken on a continuous basis, or the meter may be triggered to "freeze" readings at a specific time. Time may be measured either in seconds or cycles of the power line frequency. Timing and trigger inputs may be actuated from type A or B dry contacts or by AC or DC voltages. Special circuits assure positive triggering on first contact and prevent simultaneous start/stop conditions. Options and adapters are available for DC current, DC voltage, fast frequency measurement, low pass filters and BCD outputs.

APPLICATIONS

- Ideal for electric utility use.
- Testing of trip points on overcurrent, overvoltage, undercurrent, undervoltage, and underfrequency relays.
- With Model 314 Phase Angle Meter, ideal for impedance relays.
- Precision measurement of frequency.

SPECIFICATIONS

Frequency Range: 47-450 Hz. (25 Hz available on request.)
AC Voltage: 15 mV to 1000 V RMS, 1.5, 15, 150, 1000 V FS, transformer isolated, 5000 ohms per volt.
AC Current: 1.5 mA to 100 A RMS, 0.15, 1.5, 15, 100 A FS, transformer isolated, .001 ohms insertion resistance.
Time Interval (2 ranges): 0 to 999.99 seconds in .001 second increments. 0 to 9999.9 cycles in 0.1 cycle increments.
Trigger Inputs: (Start and Stop) Contact closure, DC step voltage change, or AC input.
Accuracies: V, I, for 57-63 Hz ±0.25% reading ±0.025% FS, for 25-450 Hz ±0.4% reading ±0.04% FS; Time, ±0.003% reading ± last digit.
Out of Range: Display blinks when level is too high.
Measurement Modes: Continuous, triggered, and "hold maximum."
Dielectric Test: 4250 V RMS to ground from V and I terminals. 1600 V RMS to ground from trigger terminals. (Per ANSI-C39.5.) Also meets SWC test.
Power Supply: 95 to 140 or 190 to 280 V RMS, 47 to 450 Hz, 20 watts, International Universal type connector.
Operating Temp. Range: 0°F. to 125°F.
Size: Portable, weatherproof, with cover 11″ L x 7″ W x 9½″ D; without cover 11″ L x 7″ W x 7″ D (Panel 11″ x 7″); shipping 11″ x 14″ x 18″.
Weight: 10 lbs. (5 kg.); shipping 17 lbs. (8 kg.).

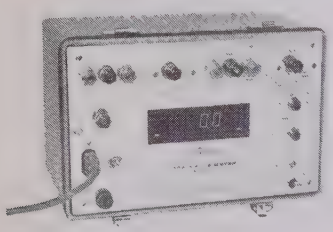
OPTIONAL FEATURES

Option 101: Fast frequency measurement capability — 0.1 sec. meas. time, 0.01 Hz resolution; 1 sec., .001 Hz resolution; accuracy ±0.002 Hz ± resolution.
Option Set 102 and 105: True RMS detection and low pass filters for removing effects of harmonics from measurements.
Option 103: BCD outputs suitable for driving printers for recording measured data. DTL/TTL compatible.
Option 106: Panel mount.
Option 107: Panel mount with remote display.
Option Set 108 and 109: Dry contacts corresponding to START/STOP times and accessory power for 325-PA-( ) adapters.
325-PA-1001: DC Current Adapter.
325-PA-1002: DC Voltage Adapter.
325-PA-1003: Contact Opening Trigger Adapter.
MR16-2 Rack Mount: 19″ rack plate and dust cover.

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 325 A

SERIES 314

POWER SYSTEM PHASE ANGLE METER / FOR ACCURATE & RAPID MEASUREMENT OF PHASE ANGLE IN ELECTRIC POWER SYSTEMS



FEATURES

- Universal Current-Voltage Inputs, V-V, I-I, V-I
- Portable
- Immune to Harmonics
- Independent of Frequency Changes
- Digital Readout — "No Hands" Simplicity
- Accuracy ±0.5°, Resolution ±0.1°
- Independent of Input Levels
- Complete input isolation

APPLICATIONS

- Testing and Adjustment of Protective Relays
- Measuring Load Current Phase Angles—Measuring Power Factor
- Testing Polyphase Balance
- Determining Power Flow in Interconnected Systems
- Minimizing Circulating Reactive Currents
- Synchronizing Multiple Sources

Accurate, precise and rapid phase measurement is an essential technique in the setup, operation, and maintenance of modern power systems, subsystems, and the control and protection circuits used in them. The value of a phase meter in such applications is directly proportional to the speed, convenience, and validity with which it indicates the phase angles it measures. With the introduction of the Dranetz Model 314, virtually all of the limitations and error sources of electromechanical meters have been removed, and the overall accuracy of this class of phase measurements has been increased by more than a full order of magnitude. The basic accuracy of ±0.5° specified for the Model 314 is actually **maintained, without degradation,** over the wide ranges of frequency variation, voltage/current level, and harmonic content for which the instrument is rated. Furthermore, the direct-reading **digital** presentation of phase, to four-place resolution (0.1° increments) requires no interpretation or interpolation, and is not subject to reading errors or parallax. **The phase angle you see is the phase angle that exists — to within ±0.5°,** without correction or uncertainty.

SPECIFICATIONS

ELECTRICAL

Range: 000.0° to 360.0°, Direct-reading
Frequency Range: 47-53, 57-63 Hz (specify at time of ordering)
Input Current Range: (both input circuits) .015-50 A rms
Input Voltage Range: (both input circuits) 0.3 to 600 V rms
Current-Input Impedance: Approx. 2 or 20 milliohms
Display: Four digits, non-flickering, 0.6″ numerals
Resolution: 0.1°
Accuracy: ±0.5°
Burden:
Voltage: 1.8 VA max. at 600 V rms input
Current: Approx. 2.5 VA at 50 A rms input
Interaction Between Inputs: None
Errors Due to Harmonic Distortion: None for harmonic distortion up to 30%, any harmonic
Errors Due to Offground Inputs or Reversal: None
Overload:
Voltage: 100% overload for 1 minute
Current: 100 A rms for 1 minute
Dielectric Test: Up to 2200 Volts rms between inputs and ground (ANSI-C39.5)
Self-Check: Provided for 000.0°. Full scale (360.0°) is autocalibrated internally
Power Required: 115/230 V, 50-60 Hz, 20 Watts

MECHANICAL AND ENVIRONMENTAL

Size: Portable, weatherproof carrying case with cover 11″ L x 7″ W x 9½″ D; without cover 11″ L x 7″ W x 7″ D (Panel 11″ x 7″); shipping 11″ x 14″ x 18″.
MR16-1 Rack Mount (optional): 19″ rack plate and dust cover.
Operating Temperature Range: 10°F to 110°F.
Weight: 10 lbs. (5 kg.); shipping 17 lbs. (8 kg.).

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 314A

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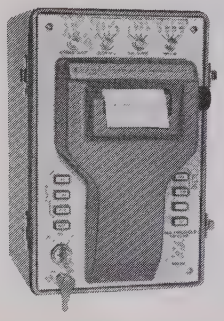
SERIES 606

POWER LINE DISTURBANCE ANALYZER/RECORDER



- For 115/230/460 V rms, 1 and 3 phase systems.
- Monitors, classifies, times and prints out line disturbances.
- Immediate and day-end printouts.
- Operates on command or disturbance — no wasted paper.
- For portable or permanent installation.
- 4 hour internal carry over power.

The 606 is designed specifically for monitoring power lines connected to computers, process control systems, hospital equipment and data communications devices, which are particularly susceptible to line transients, level changes or other disturbances. Using a digital microprocessor, the 606 classifies each disturbance into IMPULSE, CYCLE-TO-CYCLE CHANGE or SLOW RMS CHANGE. When preset thresholds are exceeded, the instrument prints out time, classification, magnitude, duration and channel designation. Data is also accumulated for overflow and day-end printout. The instrument is designed for unattended monitoring in a permanent installation or for temporary use at more than one site.

SPECIFICATIONS

Input Voltage Ranges: 115, 230, 460 V rms ±50%, all transformer isolated, Zin > 100 kΩ

Number of Inputs: Model 606-1, 1 input; Model 606-3, 3 inputs (3φ or separate circuits)

Test Modes:

AVG+ or AVG−: Increase or decrease in steady state rms, averaged over 10 sec

SURGE or SAG: Increase or decrease in cycle-to-cycle rms value

IMPULSE: 0-peak value of impulse (excluding line voltage waveform) having duration 0.5-100 μsec

ACCUMULATED COUNT: Summation of disturbance data in memory (includes time, HI AVERAGE, LO AVERAGE, HI SURGE and number of HITS, LO SAG and number of HITS, HI IMPULSE and number of HITS)

Printing Modes:

AVG+ or AVG−: Prints time, AVG+ or AVG−, rms VALUE, CHAN., when exceeding threshold of 3, 5, 10, 15 V rms*

SURGE or SAG: Prints time, SURGE or SAG, rms VALUE, CHAN. and duration (cycles) when exceeding threshold of 3, 5, 10, 15 V rms*

IMPULSE: Prints time, IMPULSE, 0-pk VALUE (excluding line voltage) and CHAN, when exceeding 0-pk threshold of 50, 100, 200, 400 V

SUPPLY DOWN or UP: Prints POWER OFF or POWER ON and TIME

STORED DISTURBANCES: Stores data on disturbances during printing. Prints out when printer clears

ACCUMULATED COUNT (Short Term): Overflow of data entering printer. Prints out automatically

DAILY ACCUMULATED COUNT: End-of-day print out. Prints number of day and ACCUMULATED COUNT

TEST: Prints time and ACCUMULATED COUNT

RESET: Prints time and ACCUMULATED COUNT, resets memory

PRINT OFF: Prints PRINT OFF and TIME, disables printer, all data goes into accumulator for delayed summary printout

Accuracy:

AVG+ or AVG−: At 60 Hz (sine wave signal), ±1% of reading ±1% of nominal input

SURGE or SAG: At 60 Hz (sine wave signal), ±1% of reading ±1% of nominal input

IMPULSE: ±5% of reading ±1% of maximum impulse calibrated with a positive going, 10 μsec, half sinewave impulse. 6 dB bandwidth with half sinewave impulses: 100 μsec to 0.5 μsec

Clock: Indicates real time in hours, minutes, seconds, crystal controlled. During power off, operates on internal batteries (4 hours). Clock resets from front panel buttons

Printer: 18 character, alpha-numeric, thermal, paper 2¼″ wide, prints 1 line/sec

Supply Power: 90 to 140 V rms, 45-450 Hz, 1φ, 1.0 A maximum (also DC operation 120-170 V maximum).

Case: Portable, removable cover with carrying handle.

Size (with cover): 11″ H x 7″ W x 9½″ D; shipping 11″ x 14″ x 18″.

Weight: 16 lbs. (7 kg.); shipping 24 lbs. (11 kg.).

Options: Opt. 101 (606-3 only), freq. disturbances; Opt. 102, 115/230 V supply power (switch selectable), 45-65 Hz; Opt. 103 (606-3, Opt. 101 only), monitors 400 Hz power lines; Opt. 104, external event indication; MR15 Rack Mount Series, 19″ rack plate and dust cover.

Model K103 Test Kit: Includes disturbance generator designed to verify operation of Series 606. Also includes a card puller, an extender card, and a set of programmed memories for assisting in calibration and troubleshooting.

Model 910 Uninterruptible Power Supply: For complete operation of 606 during power shutdown up to 2 hours. Fully protected from impulses to 1600 Volts, sags and surges of 50%, and total power interruptions.

Input (under normal conditions): 115/230 V rms nominal (switch selectable), 45-65 Hz, 1φ, 1.0 A maximum.

Output: 120 to 170 Volts, DC, 1.0 A.

Recharging Time: 18 hours.

Size: Portable carrying case same size as 606.

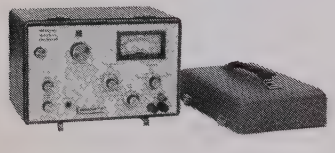
Weight: 35 pounds (16 kg.).

*These values for 115 V input; multiply by x2 or x4 for 230 V rms or 460 V rms.

FOR FULL INFORMATION WRITE FOR BULLETIN 606A

SERIES 602

FREQUENCY SELECTIVE VOLTMETER



- Broad range — 2 kHz to 350 kHz.
- High selectivity — spurious signals down more than 50 dB.
- Battery powered — long life.
- Excellent for K and N carrier systems.
- Meets W.E. KS-15538-L5A

The Dranetz Model 602 Frequency Selective Voltmeter is a low power transistorized instrument for the measurement of carrier signals hidden among other multiple signals. The instrument uses a frequency selective detector based on heterodyning to cover a broad frequency range, and uses a crystal oscillator for frequency and level calibration. The instrument has both high impedance and bridging inputs for 135 or 600 ohms (balanced or unbalanced).

SPECIFICATIONS

Frequency Range: 2-350 kHz

Input Levels:

Full Scale Ranges: −60 to +20 dBm, 5 dB/step

Sensitivity: −70 to +22 dBm

Selectivity: Spurious output down more than 50 dB

Accuracy:

Level: 135 ohm input, ±.25 dB
600 ohm input, ±.5 dB

Calibrator: ±.25 dB at 35 kHz ±250 Hz

Frequency: ±1 kHz or ±500 Hz

Frequency Response: ±1 dB ref 25 kHz

Meter Bandwidth: Nominal 500 Hz at −3 dB, 1000 Hz at −60 dB

Audio Bandwidth: Nominal 2.5 kHz at −6 dB, 8 kHz at −60 dB

Internal Noise: At least 20 dB below full scale

Battery Drain: 80 mA nominal

Size: 11″L x 7″W x 9½″D (28cm L x 18cm W x 24cm D) with cover; panel 7″ x 11″; shipping 11″ x 14″ x 18″

Weight: 10 lbs. (5 kg.); shipping 15 lbs. (7 kg.)

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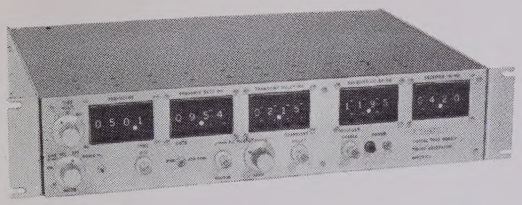
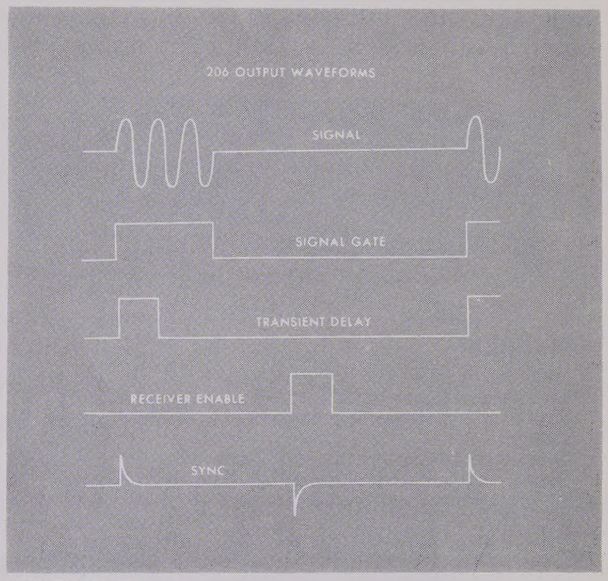
SERIES 206A

DIGITAL GATING/TIMING GENERATOR





Series 206A GATING/TIMING GENERATORS gate the output of an a-c signal generator and provides a single signal burst or repetitive signal bursts, with turn-on and turn-off times coincident with zero crossings of the input signal to minimize switching transients.

Internal or external triggering initiates an accurate sequence of pulses for: (1) turning on the signal at its first positive going zero crossing; (2) turning off the signal at the first positive going zero crossing following a precise time interval; (3) delayed triggering of oscilloscopes or other devices; (4) gating detectors or receivers after a precise time interval; (5) delayed triggering of Dranetz Series 215 AC Sampling Voltmeters or Series 202 CW/Pulse Vector Component Computer systems.

APPLICATIONS:

- Automatic a-c testing of components and circuits.
- Testing of data communications systems, modems, multiplexers and switching circuits.
- Calibration of underwater transducers under tone burst conditions.
- Measurement of propagation and reflections in acoustical fields.

FEATURES:

- Wide frequency range of 50 Hz to 3 MHz.
- Provides zero-crossing turn-on and turn-off of a-c signals, single or repetitive gating.
- Provides three additional independently selectable timing pulses for controlling gated detectors and receivers.
- Digitally-controlled timing from front panel controls.
- Remote programming.

SPECIFICATIONS

MODES OF OPERATION:
CW
Gated: (for CW, FM or Phase-shifted signals).
Single shot or repetitive gating of AC signals.
Repetitive gating using internal timing oscillator (with or without sync. to 60 Hz power line).

SIGNAL CHANNEL:
Frequency range: 50 Hz to 3 MHz.
Input: — Sinusoidal signal, 1 V rms ±10%.
Impedance—10 kΩ shunted by 100 pF.
Output: Level — Adjustable from 0.1 to 1 V rms into 75Ω load over full frequency range; adjustable from 0.5 to 5 V rms into 10kΩ up to 2 MHz.
Distortion — Less than ½% from 50 Hz to 0.5 MHz; <1% to 3 MHz.
Input to output isolation: >60 dB to 0.5 MHz; noise typically 60 dB down.
Types of gating: Zero crossing turn on and zero crossing turn off; less than 1.5° or 25 nsec coincidence error. Non-synchronous turn-on and turn-off.

EXTERNAL TRIGGER:
Pulse or square wave input, ±5 V into 3 kΩ load, transformer input, rise time 50 μsec max, duration 50 μsec. min.

GROUNDING:
Separate chassis, circuit and power line grounds.

CONNECTIONS:
Connections on rear; monitor outputs on front.

CONTROLLED TIMING:
Repetition Period: 100 μsec to 99.99 sec.
Signal On-Time: 10 μsec to 9.999 sec.
Transient Delay Pulse: 10 μsec to 9.999 sec.
Receiver Delay: 10 μsec to 9.999 sec.
Receiver On-Time: 10 μsec to 9.999 sec. (Note: Timing operates with or without AC signal input.)

OUTPUT CONTROL PULSES:
Sync. Output: +5 V pulse at signal turn-on followed by −5 V pulse at delayed receiver turn-on.
Signal gate output (for use with commercial E-I Normalizers): +10 V rectangular wave, having leading edge coincident with signal turn-on and lagging edge coincident with signal turn-off.
Signal transient delay output: +10 V rectangular wave having lagging edge coincident with setting of Transient Delay Control.
Receiver enable output: +10 V rectangular wave having leading edge corresponding to Receiver Delay Control, and pulse width corresponding to Receiver On-Time Control.

EXTERNAL PROGRAMMABLE FEATURE:
Parallel BCD rear panel inputs for each timing control. Remote operation on zero position of manual controls. Switch closure to ground or application of 0 to +0.8 V dc is binary one; open circuit or application of +2 to +5 V dc is binary zero. For switch closure, Model 206A produces 3.2 mA dc max. For manual setting of controls, rear connectors produce BCD outputs corresponding to control positions.

INPUT POWER:
105 - 125 V 50 - 60 Hz, 40 watts.
SIZE: 3½" high x 17" wide x 15½" deep (with hardward for mounting in standard 19" relay rack).
WEIGHT: 20 pounds; shipping, 30 pounds.

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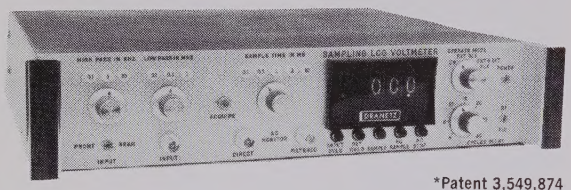
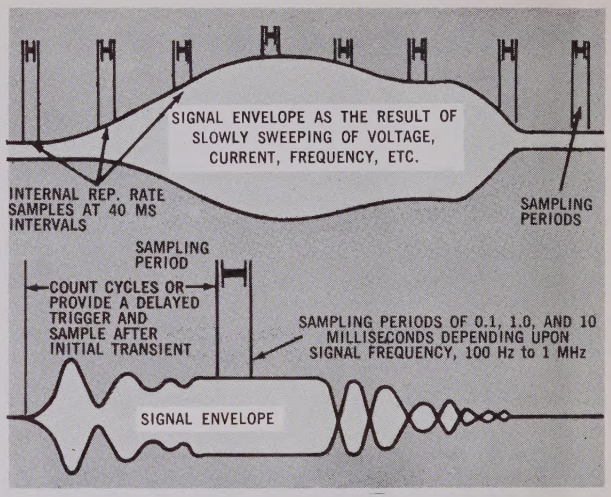
SERIES 220A

HIGH SPEED LOG SAMPLING VOLTMETER*

Direct digital readout of CW, Gated AC, or rapidly varying AC signals



*Patent 3,549,874


SIGNAL ENVELOPE AS THE RESULT OF SLOWLY SWEEPING OF VOLTAGE, CURRENT, FREQUENCY, ETC.
INTERNAL REP. RATE SAMPLES AT 40 MS INTERVALS
SAMPLING PERIODS
SAMPLING PERIOD
COUNT CYCLES OR PROVIDE A DELAYED TRIGGER AND SAMPLE AFTER INITIAL TRANSIENT
SAMPLING PERIODS OF 0.1, 1.0, AND 10 MILLISECONDS DEPENDING UPON SIGNAL FREQUENCY, 100 Hz to 1 MHz
SIGNAL ENVELOPE

FEATURES:

- Frequency range - 100 Hz to 1 MHz
- Sample and hold output - analog and digital outputs
- Single or repetitive measurement to 1000 samples per second
- Sampling times down to 100 μsec
- Output independent of sampling time or duty cycle
- 84 dB dynamic range - 300 μV to 5 V (to 5 kV with voltage probes)
- Logarithmic digital display and BCD outputs
- Complete programmability for either remotely controlled or computer controlled test systems
- Rejects unwanted signals up to 50 dB higher than desired signal

APPLICATIONS:

- High speed component testing
- Analysis of time-varying or transient effects
- Measurement of direct or reflected acoustical signals
- Measurement of signal burst levels applied to radiators or receivers.

The Model 220A Sampling Voltmeter is a gated, average responding voltmeter for measuring amplitude of AC signals during a short sampling time. Measurement can be made of rapidly varying CW signals, gated AC signals (tone bursts), or single shot AC signals. Measurements are made at any predetermined time in a selected period which can be as short as 1 cycle of the signal.

Sample and hold output circuitry, combined with internal logarithmic conversion, provide several simultaneous outputs: a digital panel meter reading directly in DBV (ref: 0 DBV = 1 V rms), a linear DC output, two logarithmic DC outputs, and a logarithmic digital output (BCD code) corresponding to the digital panel meter reading. Provision is made for insertion of an external DC signal which allows both the digital display and BCD output to correspond to other logarithmic parameters without effecting instrument calibration.

This instrument combines internal low and high pass filtering, a unique average responding detector, and logarithmic conversion to offer an exceptionally wide dynamic range, high sensitivity, wide frequency range, short sampling time and low susceptibility to noise and signal distortion compared to peak responding and rms AC instruments.

SPECIFICATIONS Model 220A

Signal Frequency Range: 100 Hz to 1 MHz.

Accuracy: ±0.3 dB to 200 kHz, ±0.5 dB 200 kHz to 1 MHz.

Resolution: Analog output - infinite Digital readout and output: 0.1 dB.

Dynamic Input Range: −70 to +14 dBV (ref. 0 dBV = 1.0 V rms) (0.3 mV to 5 V rms).

Input Circuit Configuration: Single ended, front and rear panel input jacks (BNC)

Signal Input Impedance: 1 megohm

Output Indication: (1) Digital panel meter: −70 to +14 dBV, ±199.9 dB max. indication with external DC scaling input (2) DC analog outputs, Zo = 600Ω, drives 10kΩ min. load resistance:

A. Log, 0.05 V/dB, +0.0 to +4.2 V out.

B. Log, 1 mV/dB −70.0 mV to +14.0 mV (0 V dc out ref 1 Vrms in).

C. Linear, +0.5 to +5 V dc.

(3) BCD outputs, 12 lines (8-4-2-1 BCD) TTL, DTL compatible logic

Offset Scaling: Adjustable DC offset of digital display and log output (1 mV/dB); front panel control for continuous 0 to ±100 dB offset.

Repetition Rate: Internal trigger generator approx. 10 samples/second. External trigger: 1 to 4 ms required between samples for analog DC outputs depending upon sample time; 10 msec min repetition rate for digital display and BCD outputs.

Sampling Period: Periods approx. 0.1, 0.3, 1, 3 and 10 msec. Requires min of 1 full cycle.

Filters: 0.1, 1 and 10 kHz high pass; 0.01, 0.1 and 1 MHz low pass.

Sample and Hold Facility: Output transfers from level to level without discharge. DC outputs drift less than 0.2 dB per minute after last sample. Digital output can be programmed for infinite hold.

Trigger Input (to initiate sampling): Square wave, pulse, or step, ±5 V peak, rise time < 50 μsec (10-90%) transformer input, ungrounded, input impedance approx. 5k ohms.

Delay Control to Mask Signal Transients: Below 0.5 MHz, selectable cycle count 4 to 300 cycles; above 0.5 MHz, selectable time delay of 8 to 600 μsec.

Monitor and Control Outputs: (1) Synchronizing pulses for external equipment. (2) AC monitor outputs: Filtered and unfiltered signal level approx. 2V pk-pk; filtered output has 0.5 volt pedestal indicating sampling time. (3) Fault indicating signals available at rear panel.

Visual Indicators: For overloads, correct sampling, sampling period, low and high pass filter selection, incorrect sampling and loss of signal input.

Compatibility: Compatible with Dranetz Gating/Timing Generator 206, and other pulse generators.

Programmability (rear connectors): Compatible with DTL and TTL; also operable by remote contact closures. Filter selection, sample period, timing and other functions are programmable.

AC Input Power: 115/230 V, 50-60 Hz, 35 watts

Size: 3½" high x 17" deep x 17" wide equipped for 19" rack mounting.

Weight: 25 lbs.; Shipping, 35 lbs.

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FREE TECHNICAL ARTICLES

Prepared by the Engineering Department of Dranetz Engineering Laboratories

TM-102,081 Measurement of Power Factor in Single-Phase and Three-Phase Systems Using Phasemeter Techniques (17 page technical paper).

TP-102,980 Phasemeter Specs Can Fool You (6 page reprint from **Electronic Design,** November 22, 1976).

TP-102,981 Application Notes for Sampling Log Voltmeter (10 page technical paper).

TP-102,982 Analysis of Electroacoustic Transducers by Differential Admittance Techniques (5 page reprint from **Journal of Acoustical Society of America,** August, 1966).

TP-102,983 Recording Impedance & Admittance of Transducers under High Power (6 page reprint from **Electronic Products,** May, 1965).

TP-102,984 Application Handbook of Precision Phase Measurement (28 page publication).

TP-102,985 Advantages of Phase-Angle Measurement by Digital Techniques (7 page technical paper).

TP-102,986 Power Line Monitoring & Transient Analysis (19 page technical paper).

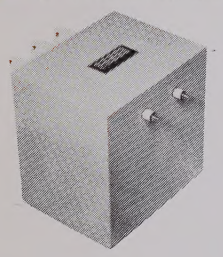
TP-102,987 Power Monitoring — It Can Help Cure Your Repair/Replacement Problems (2 page reprint from **Maintenance Engineering,** January, 1976).

TP-102,988 Tracking Down and Identifying Power Line Aberrations (4 page reprint from **Mini-Micro Systems,** July, 1976).

TP-102,991 When & How to Automate Phase Instrumentation (13 page technical paper).

TR-SERIES SPECIAL PURPOSE INSTRUMENT TRANSFORMERS

TR-2003 10 kVA STEPDOWN ISOLATION TRANSFORMERS



FEATURES

- Single ended and balanced inputs
- Excellent amplitude and phase fidelity over wide frequency range
- High input impedance — low output impedance

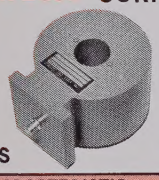
APPLICATIONS

- Measurement of amplitude and phase of high voltage sources
- Impedance, phase and power measurements on high power electroacoustical transducers
- Testing of high voltage components such as inductors and transformers

SPECIFICATIONS

Turns Ratio: 1000: 1 ±1% at 1 kHz.
Frequency Response: Amplitude: Push-pull: ±1%, 20 Hz to 30 kHz; Single-ended: ±1%, 20 Hz to 9 kHz. Phase: Push-pull: ±2°, 20 Hz to 30 kHz; Single-ended: ±2°, 20 Hz to 9 kHz.
Primary Center Tap: Within 0.5% of true center.
Max. Input Voltage: Push-pull, CT grounded: 10 kV rms, 100 Hz to 30 kHz; Single-ended: 10 kV rms, 100 Hz to 9 kHz; Peak voltage: 15 kV, either terminal to case.
Input Impedance (Vector): Above 100 Hz, approx. 2 meg. Ω; below 100 Hz, progressively decreasing with lower freq. (approx. 1 meg. Ω at 60 Hz).
Insulation to Case: Primary: 1000 megohms; Secondary: 1000 megohms.
Internal Power Absorption: Increases as square of voltage, to less than 10 W at full voltage limit.
Load Impedance: Characteristics stated herein apply for resistive loads between 1 k ohm and 10 k ohm.
Size: Approx. 6¾″ x 5¼″ x 7″ high excluding terminals and mounting studs.
Terminals: 3 Ceramic primary, 2 ceramic sec.
Breakdown to Case: Primary: 18 kV rms; Secondary: 1 kV rms.
Bias Current: DC bias current should not be placed through windings.
Construction: Steel encased, oil filled, mounting studs 5⅝″ x 3¼″ centers (studs ¼″ x 20″ x ⅝″ long).
Wt.: Approx. 26 lbs. **Ship. Wt.:** Approx. 32 lbs.

TR-2004 — TR-2005 CURRENT TRANSFORMERS



FEATURES

- Output voltage is faithful reproduction of input current
- Wide frequency and dynamic range
- Excellent pulse and phase response
- High voltage isolation
- 1¼″ D hole for primary

APPLICATIONS

- Testing sonar projectors and arrays
- High power immitance and transfer measurements
- Measuring transients in SCR's
- Measuring electron beam currents
- Current sensing in AC feedback systems

SPECIFICATIONS

CHARACTERISTIC	TR 2004	TR 2005
Sensitivity per Primary Turn (V rms/A rms)	0.1; +0, −1%	1.0; +0, −1%
Square Pulse Input		
Max. Current	10,000 A pk	1,000 A pk
Rise Time	For rise times > 1 microsec.	40 nanosec. approx.
Droop	10^{-4}%/microsec.	10^{-2}%/microsec.
Max. Amp-sec. per pulse	1	0.1
For Sinusoidal Input		
Amplitude Limit	100 A rms above 17 Hz; 9 A pk/Hz below 17 Hz; 90 A pk at 10 Hz	10 A rms above 100 Hz; 0.15 A pk/Hz below 100 Hz; 7.5 A pk at 50 Hz
Useful Frequency Range	0.25 Hz to 700 kHz	20 Hz to 10 MHz
Amplitude Response with Frequency +0%, −1% Limits		
Low Frequencies	4 Hz to 100 kHz	1 kHz to 4 MHz
	3 dB at 0.25 Hz	3 dB at 20 Hz; −3% at 200 Hz; −5% at 100 Hz
High Frequencies	3 dB up to 700 kHz; +2.5% at 300 kHz; +7% at 400 kHz	3 dB at 10 MHz
Phase Response ±0.8° Limit		
Low Frequencies	20 Hz to 100 kHz	1 kHz to 2 MHz
	1.5° at 10 Hz; 2.9° at 5 Hz	2° at 500 Hz; 4° at 250 Hz; 8° at 100 Hz; 13° at 50 Hz
High Frequencies	1.5° at 200 kHz; 2.2° at 300 kHz	2.7° at 5 MHz
Electrostatic Shielding		
With 1000 volts rms at 5 kHz on primary, secondary output corresponds to less than:	10^{-4} ampere turns through primary	10^{-5} ampere turns through primary
Maximum Insertion Impedance	0.0002 ohms	0.02 ohms
Maximum Voltage	15 kV pk surface to high voltage; 30 kV pk with primary insulation	
Typical Primary Capacitance	6 pF in oil; 3 pF in air	
Recommended Load	> 10,000 Ω in parallel with < 20 pF	
Dimensions	(approx) 5″ OD x 1¼″ ID x 2½″ high plus mounting flange (4 mounting holes on flange: ¾″ D on centers 1⅝″ x 2½″)	
Connector	BNC	
Weight	4 pounds approx.	
Shipping Weight	8 pounds approx.	

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